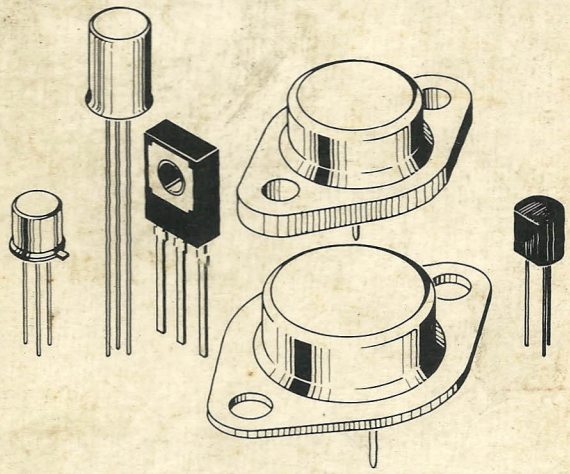
DISTRIBUIÇÃO GRATUITA

TRANSISTORES IBRAPE

1974

IBRAPE



TRANSISTORES

DADOS E CURVAS PARA PROJETOS

MARÇO DE 1974

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LIST OF LETTER SYMBOLS IN ALPHABETICAL ORDER

Letter symbol	Definition
B	Bandwidth
b_{ib}, b_{ie}, b_{is}, b_{fb}, b_{fe}, b_{fs}, b_{ob}, b_{oe}, b_{os}, b_{rb}, b_{re}, b_{rs}	See y parameters
C_c [1]	Collector capacitance (emitter open-circuited to a.c. and d.c.)
C_d [1]	Diode capacitance
C_e [1]	Emitter capacitance (collector open-circuited to a.c. and d.c.)
C_{ib}, C_{ie}, C_{is}, C_{fb}, C_{fe}, C_{fs}, C_{ob}, C_{oe}, C_{os}, C_{rb}, C_{re}, C_{rs}	See y parameters
d	Distortion
F	Noise figure
f	Frequency
f_{hfb}, f_{hfe}, f_{yfe}	Cut-off frequency (frequency at which the parameter indicated by the subscript is 0.7 of its low frequency value)
f_T	Transition frequency (Gain-bandwidth product)
g_{ie}, g_{ib}, g_{oe}, g_{ob}	See y parameters
G_p	Power gain
G_S	Source conductance
G_{tr}	Transducer gain
G_{UM}	Maximum unilateralised power gain
G_v	Voltage gain

1) As an exception to the general rule for electrical parameters capacitances are represented by the upper-case letter.

Letter symbol	Definition
h_{FB}, h_{FC}, h_{FE}	D.C. current gain (static value of the forward current transfer ratio; output voltage held constant)
h_{fb}, h_{fc}, h_{fe}	Small-signal current gain (small-signal value of the forward current transfer ratio; output short-circuited to a.c.)
h_{IB}, h_{IC}, h_{IE}	Static value of the input resistance (output voltage held constant)
h_{ib}, h_{ic}, h_{ie}	Small-signal value of the input impedance (output short-circuited to a.c.)
h_{OB}, h_{OC}, h_{OE}	Static value of the output conductance (input current held constant)
h_{ob}, h_{oc}, h_{oe}	Small-signal value of the output admittance (input open-circuited to a.c.)
h_{RB}, h_{RC}, h_{RE}	Static value of the reverse voltage transfer ratio (input current held constant)
h_{rb}, h_{rc}, h_{re}	Small-signal value of the reverse voltage transfer ratio (input open-circuited to a.c.)
I_B, I_C, I_D, I_E, I_G, I_S	Total d.c. (or average) current
I_b, I_c, I_d, I_e, I_g, I_s	Varying component of the current
i_B, i_C, i_D, i_E, i_G, i_S	Instantaneous total value of the current
i_b, i_c, i_d, i_e, i_g, i_s	Instantaneous value of the varying component of the current
$I_{B(AV)}$, $I_{C(AV)}$, $I_{E(AV)}$	Total average current (to distinguish between average and d.c. if necessary)
I_{BEX}, I_{CEX}	Total base, respectively collector current under specified conditions. These symbols are commonly used in case of a reverse biased emitter junction
I_{BM}, I_{CM}, I_{EM}	Maximum (peak) value of the total current
I_{bm}, I_{cm}, I_{em}	Maximum (peak) value of the varying component of the current
I_{CBO}	Collector cut-off current (open emitter)
I_{CEO}	Collector cut-off current (open base)
I_{CBS} or I_{CES}	Collector cut-off current (emitter short-circuited to base)

Letter symbol	Definition
I_{DSS}	Drain current (source short-circuited to gate)
I_{EBO}	Emitter cut-off current (open collector)
I_F	Total forward current of a diode (d.c. or average)
i_F	Instantaneous total value of the forward current of a diode
$I_{F(AV)}$	Total average forward current of a diode (to distinguish between average and d.c. if necessary)
I_{FM}	Peak forward current of a diode
I_{GSS}	Gate cut-off current (source short-circuited to drain)
I_i, I_o	Input, respectively output current of a specified circuit
I_R	Total reverse (cut-off) current of a diode
i_R	Instantaneous total value of the reverse current of a diode
I_{RRM}	Repetitive peak reverse current of a diode
I_{RSM}	Non-repetitive peak reverse current of a diode
I_{SDS}	Source cut-off current (drain short-circuited to gate)
I_Z	Zener current (d.c. or average)
I_{ZM}	Peak zener current
I_{ZS}	Non-repetitive zener current
P_i, P_o	Input, respectively output power of a specified circuit
P_{tot}	Total power dissipation in the device
P_Z	Zener power dissipation
P_{ZM}	Peak zener power dissipation
P_{ZSM}	Non-repetitive peak zener power dissipation
Q_s	Reverse recovery charge

Letter symbol	Definition
r_D	Diode (internal) series resistance
r_{DS}	Drain-source resistance
r_{GS}	Gate-source resistance
R_L	Load resistance
R_S	Source resistance
R_{th}	Thermal resistance
$R_{th\ j\text{-}a}$	Thermal resistance from junction to ambient
$R_{th\ j\text{-}mb}$	Thermal resistance from junction to mounting base
$R_{th\ j\text{-}c}$	Thermal resistance from junction to case
$R_{th\ mb\text{-}h}$	Thermal resistance from mounting base to heatsink (contact thermal resistance)
r_z	Dynamic-slope resistance of a zener diode
S_z	Temperature coefficient of the operating voltage of a zener diode
T_{amb}	Ambient temperature
T_{case}	Case temperature
t_d ; t_f	Delay time; fall time
t_{fr}	Forward recovery time of a diode
T_j	Junction temperature
t_{off}	Turn-off time ($t_{off} = t_s + t_f$)
t_{on}	Turn-on time ($t_{on} = t_d + t_r$)
t_r	Rise time
t_{rr}	Reverse recovery time of a diode
t_s	Storage time
T_{stg}	Storage temperature
V_{BB}, V_{CC}, V_{EE}	Supply voltage
V_{BE}, V_{CB}, V_{CE}, V_{EB}	Total value of the voltage (d.c. or average)
V_{be}, V_{cb}, V_{ce}, V_{eb}	Varying component of the voltage
v_{BE}, v_{CB}, v_{CE}, v_{EB}	Instantaneous value of the total voltage
v_{be}, v_{cb}, v_{ce}, v_{eb}	Instantaneous value of the varying component of the voltage

Letter symbols	Definition
V_{BEfl}	Base-emitter floating voltage (open base)
V_{BEsat}	Saturation voltage at specified bottoming conditions
$V_{(BR)}$	Breakdown voltage
$V_{(BR)CBO}$, $V_{(BR)CEO}$, $V_{(BR)EBO}$	Breakdown voltage between the terminal indicated by the first subscript and the reference terminal (second subscript) when the third terminal is open circuited
$V_{(BR)CER}$	Collector-emitter breakdown voltage with a specified resistance between emitter and base
$V_{(BR)CES}$	Collector-emitter breakdown voltage with the emitter short circuited to the base
V_{CBO}, V_{CEO}, V_{DGO}, V_{EBO}, V_{GSO}	Voltage of the terminal indicated by the first subscript w.r.t. the reference terminal (second subscript) with the third terminal open circuited
V_{CBOM}, V_{CEOM}	Peak value of V_{CBO}, V_{CEO}
V_{CEK}	Knee voltage at specified conditions
V_{CER}	Collector-emitter voltage with a specified resistance between emitter and base
V_{CERM}	Peak value of V_{CER}
V_{CES}	Collector-emitter voltage with the emitter short circuited to the base
V_{CEsat}	Saturation voltage at specified bottoming conditions
$V_{CE.sust}$	Collector-emitter sustaining voltage under the condition, indicated by the third subscript
V_{CEX}	Collector-emitter voltage in a specified circuit. This symbol is commonly used to indicate a reverse biased emitter junction
V_{DSS}	Drain-source voltage with the source short-circuited to the gate
V_{EBfl}	Emitter-base floating voltage (open emitter)
V_F	Continuous forward voltage of a diode
V_{FM}	Peak forward voltage of a diode

Letter symbol	Definition	
V_i, V_o	Input, respectively output voltage of a specified circuit	
$V_{(P)GS}$	Gate-source cut-off voltage	
V_R	Continuous reverse voltage of a diode	
V_{RM}	Peak reverse voltage of a diode	
V_{RSM}	Non-repetitive peak reverse voltage of a diode	
V_Z	Operating voltage (zener voltage) of a zener diode	
y_{ib}, y_{ie}, y_{is}	Input admittance	Output short circuited to a.c.
b_{ib}, b_{ie}, b_{is}	Input susceptance	
g_{ib}, g_{ie}, g_{is}	Input conductance	
C_{ib}, C_{ie}, C_{is}	Input capacitance	
φ_{ib}, φ_{ie}, φ_{is}	Phase angle of input admittance	
y_{fb}, y_{fe}, y_{fs}	Transfer admittance	Output short circuited to a.c.
b_{fb}, b_{fe}, b_{fs}	Transfer susceptance	
g_{fb}, g_{fe}, g_{fs}	Transfer conductance	
C_{fb}, C_{fe}, C_{fs}	Transfer capacitance	
φ_{fb}, φ_{fe}, φ_{fs}	Phase angle of transfer admittance	
y_{ob}, y_{oe}, y_{os}	Output admittance	Input short circuited to a.c.
b_{ob}, b_{oe}, b_{os}	Output susceptance	
g_{ob}, g_{oe}, g_{os}	Output conductance	
C_{ob}, C_{oe}, C_{os}	Output capacitance	
φ_{ob}, φ_{oe}, φ_{os}	Phase angle of output admittance	
y_{rb}, y_{re}, y_{rs}	Feedback admittance	Input short circuited to a.c.
b_{rb}, b_{re}, b_{rs}	Feedback susceptance	
g_{rb}, g_{re}, g_{rs}	Feedback conductance	
C_{rb}, C_{re}, C_{rs}	Feedback capacitance	
φ_{rb}, φ_{re}, φ_{rs}	Phase angle of feedback admittance	
Z_{th}	Transient thermal impedance	

GERMANIUM ALLOYED MEDIUM POWER TRANSISTORS

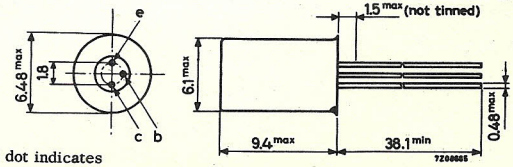
The AC187 is a n-p-n audio transistor in a TO-1 metal envelope.
The AC187 is primarily intended for use together with the p-n-p medium power transistor AC188 as matched pair AC187/AC188 in class B output stages with outputs up to about 3W.
The AC187/01 is electrically equivalent to the AC187, constructed integrally with a heat conducting block, which gives better heat transfer.
The thermal resistance from junction to heatsink shows an improvement (≈ 10 °C/W) as compared with that of the AC187 with heat conducting clip 56227.
The AC187/01 is also available as matched pair with the AC188/01.

QUICK REFERENCE DATA				
Collector-base voltage (open emitter)	V_{CBO}	max.	25	V
Collector-emitter voltage (open base)	V_{CEO}	max.	15	V
Collector current (peak value)	I_{CM}	max.	2	A
Total power dissipation up to T_{amb} = 35 °C	P_{tot}	max.	1.0	W
Junction temperature	T_j	max.	90	°C
D.C. current gain at T_j = 25 °C; I_C = 300 mA; V_{CE} = 1 V	h_{FE}		100 to 500	
Cut-off frequency; I_C = 10 mA; V_{CE} = 2 V	f_{hfe}	typ.	20	kHz

MECHANICAL DATA

Dimensions in mm

AC187
TO-1

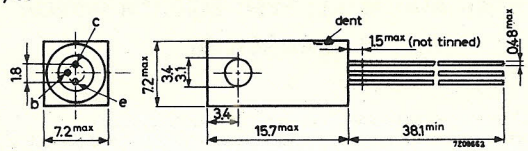


The coloured dot indicates the collector

Accessories available: 56200; 56208; 56209; 56210; 56226; 56227

MECHANICAL DATA (continued) Dimensions in mm

AC187/01



The dent indicates the collector

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	25	V
Collector-emitter voltage (open base)	V_{CEO}	max.	15	V
Collector-emitter voltage $I_C \leq 600$ mA; $R_{BE} \leq 1\ \Omega$	V_{CER}	max.	18	V
Emitter-base voltage (open collector)	V_{EBO}	max.	10	V

Currents

Collector current (d.c. or average over any 50 ms period)	I_C	max.	1	A
Collector current (peak value)	I_{CM}	max.	2	A

Power dissipation

Total power dissipation up to T_{amb} = 35 °C [1])	P_{tot}	max.	1.0	W

Temperatures

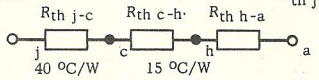
Storage temperature	T_{stg}		−55 to +75	°C
Junction temperature	T_j	max.	90	°C

[1]) The allowable peak power in class B speach and musical driven amplifiers is 1.1 W

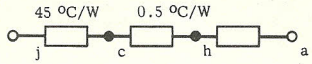
THERMAL RESISTANCE

		AC187	AC187/01	
From junction to ambient in free air				
without cooling clip	$R_{th\ j-a}$ =	290	180	°C/W
with cooling clip 56227	$R_{th\ j-a}$ =	140		°C/W
with cooling clip 56227 on 1.5 mm blackened Al. heatsink of 12.5 cm²	$R_{th\ j-a}$ =	80	70.5	°C/W
with cooling clip 56227 on infinite heatsink	$R_{th\ j-a}$ =	55		°C/W
From junction to case	$R_{th\ j-c}$ =	40	45	°C/W

AC187 with cooling clip 56227



AC187/01



CHARACTERISTICS T_j = 25 °C unless otherwise specified

Collector cut-off current

I_E = 0; V_{CB} = 25 V	I_{CBO}	typ.	15	μA
		<	100	μA
I_E = 0; V_{CB} = 25 V; T_j = 90 °C	I_{CBO}	<	2.5	mA
$-V_{BE}$ = 1.0 V; V_{CE} = 25 V	I_{CEX}	<	100	μA

Emitter cut-off current

I_C = 0; V_{EB} = 10 V	I_{EBO}	typ.	15	μA
		<	100	μA
I_C = 0; V_{EB} = 10 V; T_j = 90 °C	I_{EBO}	typ.	1.2	mA
		<	2.5	mA

Base-emitter voltage

I_C = 5 mA; V_{CE} = 10 V	V_{BE}		95 to 135	mV
I_C = 300 mA; V_{CE} = 1 V	V_{BE}	<	550	mV

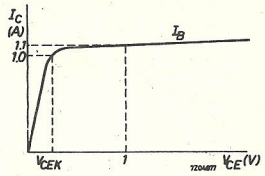
Emitter-base floating voltage

I_E = 0; V_{CB} = 25 V; T_j = 90 °C	V_{EBfl}	<	400	mV

CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

Knee voltage

I_C = 1 A; I_B = value for which I_C = 1.1 A at V_{CE} = 1 V	V_{CEK}	<	800	mV



D.C. current gain

I_C = 5 mA; V_{CE} = 10 V	h_{FE}	>	70	
I_C = 300 mA; V_{CE} = 1 V	h_{FE}	typ.	200	
			100 to 500	
I_C = 1 A; V_{CE} = 1 V	h_{FE}	>	50	

Collector capacitance at f = 450 kHz

$I_E = I_e$ = 0; V_{CB} = 5 V	C_c	typ.	150	pF
		<	180	pF

Transition frequency

I_C = 10 mA; V_{CE} = 2 V	f_T	>	1	MHz
		typ.	5	MHz

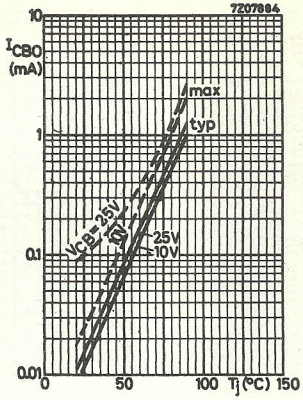
Cut-off frequency

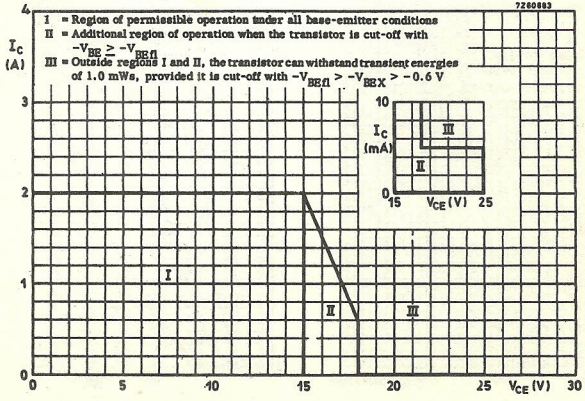
I_C = 10 mA; V_{CE} = 2 V	f_{hfe}	typ.	20	kHz

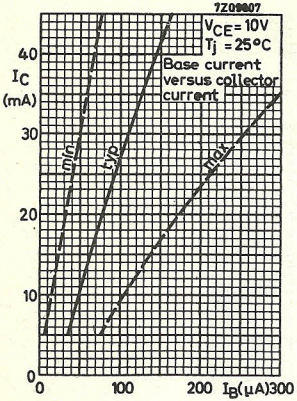
D.C. current gain ratio of matched pairs/AC187/AC188; AC187/01/AC188/01

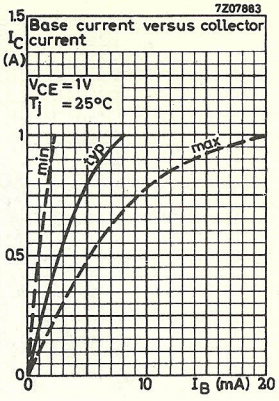
I_C = 500 mA; V_{CE} = 1 V	h_{FE1}/h_{FE2}	<	1.25	

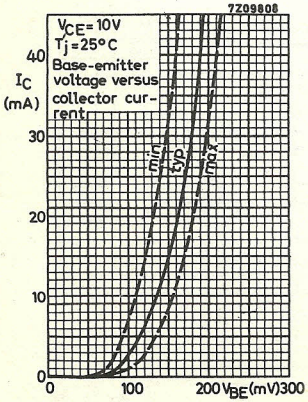
AC187 AC187/01
AC187/AC188

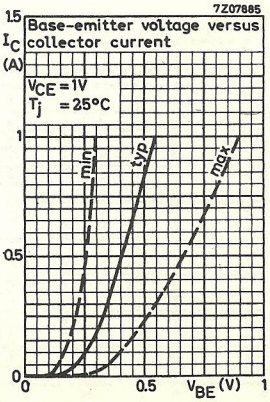












GERMANIUM ALLOYED MEDIUM POWER TRANSISTORS

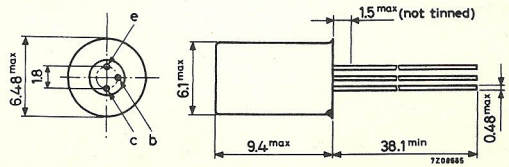
The AC188 is a p-n-p audio transistor in a TO-1 metal envelope.
The AC188 is primarily intended for use as matched pair 2-AC188 or together with the n-p-n medium power transistor AC187 as matched pair AC187/AC188 in class B output stages with outputs up to about 3 W.
The AC188/01 is electrically equivalent to the AC188, constructed integrally with a heat conducting block, which gives better heat transfer.
The thermal resistance from junction to heatsink shows an improvement (≈ 10 °C/W) as compared with that of the AC188 with heat conducting clip 56227. The AC188/01 is also available as matched pair with the AC187/01 or as 2-AC188/01.

QUICK REFERENCE DATA				
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	25	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	15	V
Collector current (peak value)	$-I_{CM}$	max.	2	A
Total power dissipation up to T_{amb} = 35 °C	P_{tot}	max.	1.0	W
Junction temperature	T_j	max.	90	°C
D.C. current gain at T_j = 25 °C				
$-I_C$ = 300 mA; $-V_{CE}$ = 1 V	h_{FE}	100 to 500		
Cut-off frequency				
$-I_C$ = 10 mA; $-V_{CE}$ = 2 V	f_{hfe}	typ.	10	kHz

MECHANICAL DATA

AC188

TO-1

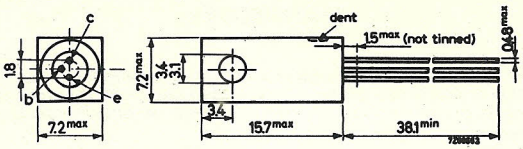


The coloured dot indicates the collector

Accessories available: 56200; 56208; 56209; 56210; 56226; 56227

MECHANICAL DATA (continued) Dimensions in mm

AC188/01



The dent indicates the collector

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	25	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	15	V
Collector-emitter voltage $-I_C \leq 600$ mA; $R_{BE} \leq 1\ \Omega$	$-V_{CER}$	max.	18	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	10	V

Currents

Collector current (d.c. or average over any 50 ms period)	$-I_C$	max.	1	A
Collector current (peak value)	$-I_{CM}$	max.	2	A

Power dissipation

Total power dissipation up to $T_{amb} = 35\ ^oC$ [1])	P_{tot}	max.	1.0	W

Temperatures

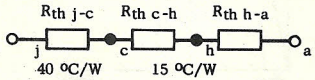
Storage temperature	T_{stg}		−55 to +75	°C
Junction temperature	T_j	max.	90	°C

[1]) The allowable peak power in class B speach and musical driven amplifiers is 1.1 W

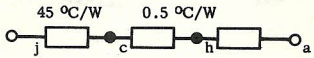
THERMAL RESISTANCE

From junction to ambient in free air			AC188	AC188/01	
without cooling clip	$R_{th\ j-a}$	=	290	180	°C/W
with cooling clip 56227	$R_{th\ j-a}$	=	140	.	°C/W
with cooling clip 56227 on 1.5 mm Al blackened heatsink of 12.5 cm²	$R_{th\ j-a}$	=	80	70.5	°C/W
with cooling clip 56227 on infinite heatsink	$R_{th\ j-a}$	=	55		°C/W
From junction to case	$R_{th\ j-c}$	=	40	45	°C/W

AC188 with cooling clip 56227



AC188/01



CHARACTERISTICS $T_j = 25\ ^oC$ unless otherwise specified

Collector cut-off current

$I_E = 0$; $-V_{CB} = 25$ V	$-I_{CBO}$	typ.	20	μA
		<	200	μA
$I_E = 0$; $-V_{CB} = 25$ V; $T_j = 90\ ^oC$	$-I_{CBO}$	<	1.4	mA
$+V_{BE} = 1.0$ V; $-V_{CE} = 25$ V	$-I_{CEX}$	<	200	μA

Emitter cut-off current

$I_C = 0$; $-V_{EB} = 10$ V	$-I_{EBO}$	typ.	15	μA
		<	200	μA
$I_C = 0$; $-V_{EB} = 10$ V; $T_j = 90\ ^oC$	$-I_{EBO}$	typ.	0.4	mA
		<	1.4	mA

Base-emitter voltage

$-I_C = 5$ mA; $-V_{CE} = 10$ V	$-V_{BE}$		115 to 145	mV
$-I_C = 300$ mA; $-V_{CE} = 1$ V	$-V_{BE}$	<	450	mV

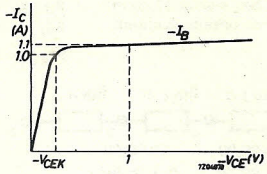
Emitter-base floating voltage

$I_E = 0$; $-V_{CB} = 25$ V; $T_j = 90\ ^oC$	$-V_{EBfl}$	<	400	mV

CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

Knee voltage

$-I_C$ = 1 A; $-I_B$ = value for which
$-I_C$ = 1.1 A at $-V_{CE}$ = 1 V — $-V_{CEK}$ < 600 mV



D.C. current gain

$-I_C$ = 5 mA; $-V_{CE}$ = 10 V	h_{FE}	>	70
$-I_C$ = 300 mA; $-V_{CE}$ = 1 V	h_{FE}	typ.	200
			100 to 500
$-I_C$ = 1 A; $-V_{CE}$ = 1 V	h_{FE}	>	80

Collector capacitance at f = 450 kHz

$I_E = I_e$ = 0; $-V_{CB}$ = 5 V	C_c	typ.	90	pF
		<	110	pF

Transition frequency

$-I_C$ = 10 mA; $-V_{CE}$ = 2 V	f_T	>	1	MHz
		typ.	1.5	MHz

Cut-off frequency

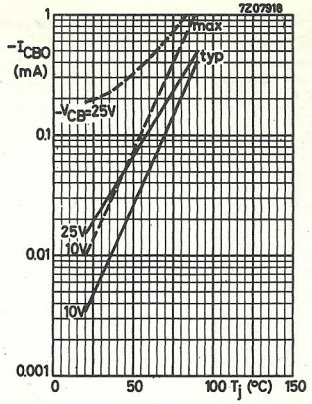
$-I_C$ = 10 mA; $-V_{CE}$ = 2 V	f_{hfe}	typ.	10	kHz

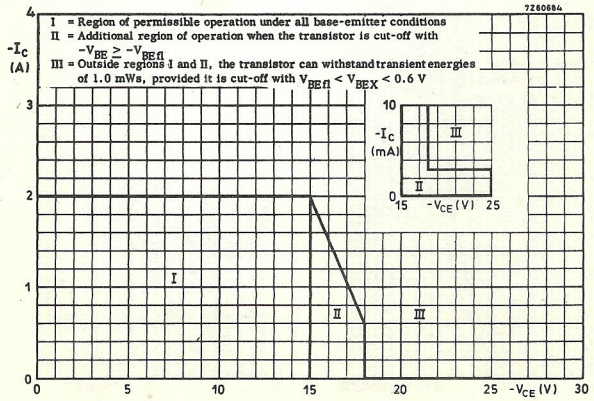
D.C. current gain ratio of
matched pairs AC187/AC188; AC187/01/AC188/01

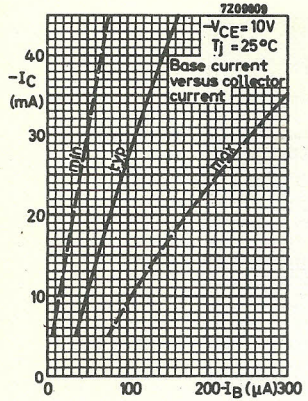
$\|I_C\|$ = 500 mA; $\|V_{CE}\|$ = 1 V	h_{FE1}/h_{FE2}	<	1.25

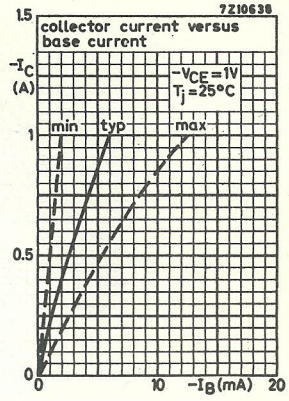
matched pairs 2-AC188; 2-AC188/01

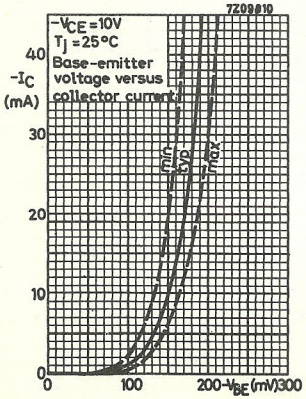
$-I_C$ = 50 mA; $-V_{CE}$ = 1 V	h_{FE1}/h_{FE2}	<	1.25
$-I_C$ = 500 mA; $-V_{CE}$ = 1 V	h_{FE1}/h_{FE2}	<	1.25

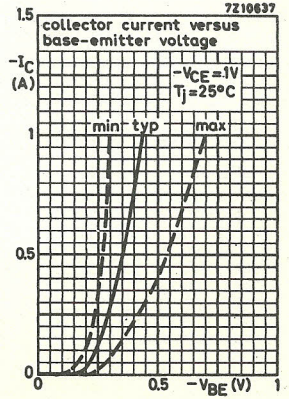












A.F. SILICON PLANAR EPITAXIAL TRANSISTORS

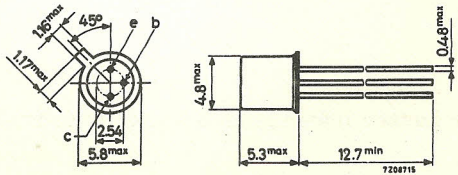
N-P-N transistors in a TO-18 metal envelope with the collector connected to the case.
The BC107 is primarily intended for use in driver stages of audio amplifiers and in signal processing circuits of television receivers.
The BC108 is suitable for a multitude of low voltage applications e.g. driver stages or audio pre-amplifiers and in signal processing circuits of television receivers.
The BC109 is primarily intended for low noise input stages in tape recorders, hi-fi amplifiers and other audio frequency equipment.

QUICK REFERENCE DATA

			BC107	BC108	BC109	
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	50	30	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	20	20	V
Collector current (peak value)	I_{CM}	max.	200	200	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	300	300	mW
Junction temperature	T_j	max.	175	175	175	°C
Small signal current gain at T_j = 25 °C I_C = 2 mA; V_{CE} = 5 V; f = 1 kHz	h_{fe}	> <	125 500	125 900	240 900	
Transition frequency at f = 35 MHz I_C = 10 mA; V_{CE} = 5 V	f_T	typ.	300	300	300	MHz
Noise figure at R_S = 2 kΩ I_C = 200 μA; V_{CE} = 5 V						
f = 30 Hz to 15 kHz	F	typ. <			1.4 4	dB dB
f = 1 kHz; B = 200 Hz	F	typ.	2	2	1.2	dB

MECHANICAL DATA Dimensions in mm

Collector connected to case
TO-18



Accessories available: 56246; 56263

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages			BC107	BC108	BC109	
Collector-base voltage (open emitter)	V_{CBO}	max.	50	30	30	V
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	50	30	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	20	20	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6	5	5	V

Currents				
Collector current (d.c.)	I_C	max.	100	mA
Collector current (peak value)	I_{CM}	max.	200	mA
Emitter current (peak value)	$-I_{EM}$	max.	200	mA
Base current (peak value)	I_{BM}	max.	200	mA

Power dissipation				
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW

Temperatures				
Storage temperature	T_{stg}		−65 to +175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.5	°C/mW
From junction to case	$R_{th\ j\text{-}c}$	=	0.2	°C/mW

For further information see BC547 to BC549

A.F. SILICON PLANAR EPITAXIAL TRANSISTORS

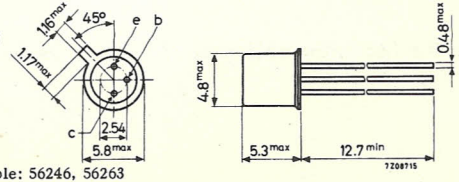
P-N-P transistors in a TO-18 metal envelope with the collector connected to the case. The BC177 is a high voltage type and primarily intended for use in driver stages of audio amplifiers and in signal processing circuits of television receivers.
The BC178 is suitable for a multitude of low voltage applications e.g. driver stages or audio pre-amplifiers and in signal processing circuits of television receivers.
The BC179 is primarily intended for low noise input stages in tape recorders, hi-fi amplifiers and other audio frequency equipment.
Moreover they are intended as complementary types for the BC107, BC108 and BC109.

QUICK REFERENCE DATA

			BC177	BC178	BC179	
Collector-emitter voltage (+V_{BE} = 1 V)	$-V_{CEX}$	max.	50	30	25	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	25	20	V
Collector current (peak value)	$-I_{CM}$	max.	200	200	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	300	300	mW
Junction temperature	T_j	max.	175	175	175	°C
Small signal current gain at T_j = 25 °C						
$-I_C$ = 2 mA; $-V_{CE}$ = 5 V; f = 1 kHz	h_{fe}	>	75	75	125	
		<	260	500	500	
Transition frequency at f = 35 MHz						
$-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	typ.	150	150	150	MHz
Noise figure at R_S = 2 kΩ						
$-I_C$ = 200 μA; $-V_{CE}$ = 5 V						
f = 30 Hz to 15 kHz	F	typ.			1.2	dB
		<			4	dB
f = 1 kHz; B = 200 Hz	F	<	10	10	4	dB

MECHANICAL DATA Dimensions in mm

TO-18
Collector connected to case



Accessories available: 56246, 56263

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134).

Voltages			BC177	BC178	BC179	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	50	30	25	V
Collector-emitter voltage ($+V_{BE}$ = 1 V)	$-V_{CEX}$	max.	50	30	25	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	25	20	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	5	V

Currents				
Collector current (d.c.)	$-I_C$	max.	100	mA
Collector current (peak value)	$-I_{CM}$	max.	200	mA
Emitter current (peak value)	I_{EM}	max.	200	mA

Power dissipation				
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW

Temperatures				
Storage temperature	T_{stg}		-65 to +175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.5	°C/mW
From junction to case	$R_{th\ j\text{-}c}$	=	0.2	°C/mW

For further information see BC557 to BC559

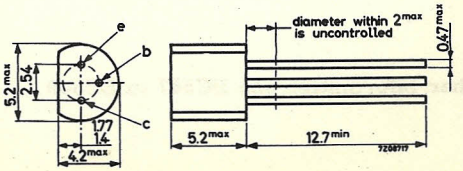
A.F. SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in a plastic envelope.
The BC237 is primarily intended for use in driver stages of audio amplifiers and in signal processing circuits of television receivers.
The BC238 is suitable for a multitude of low voltage applications e.g. driver stages or audio pre-amplifiers and in signal processing circuits of television receivers.
The BC239 is primarily intended for low noise input stages in tape recorders, hi-fi amplifiers and other audio frequency equipment.

QUICK REFERENCE DATA

			BC237	BC238	BC239	
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	50	30	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	20	20	V
Collector current (peak value)	I_{CM}	max.	200	200	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	300	300	mW
Junction temperature	T_j	max.	125	125	125	°C
Small signal current gain at T_j = 25 °C I_C = 2 mA; V_{CE} = 5 V; f = 1 kHz	h_{fe}	> <	125 500	125 900	240 900	
Transition frequency at f = 35 MHz I_C = 10 mA; V_{CE} = 5 V	f_T	typ.	300	300	300	MHz
Noise figure at R_S = 2 kΩ I_C = 200 μA; V_{CE} = 5 V						
f = 30 Hz to 15 kHz	F	typ. <			1.4 4	dB dB
f = 1 kHz; B = 200 Hz	F	typ.	2	2	1.2	dB

MECHANICAL DATA Dimensions in mm



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

			BC237	BC238	BC239	
Collector-base voltage (open emitter)	V_{CBO}	max.	50	30	30	V
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	50	30	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	20	20	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6	5	5	V

Currents

Collector current (d.c.)	I_C	max.	100	mA
Collector current (peak value)	I_{CM}	max.	200	mA
Emitter current (peak value)	$-I_{EM}$	max.	200	mA
Base current (peak value)	I_{BM}	max.	200	mA

Power dissipation

Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW

Temperatures

Storage temperature	T_{stg}		−65 to +125	°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.33	°C/mW

For further information see BC547 to BC549

A.F. SILICON PLANAR EPITAXIAL TRANSISTORS

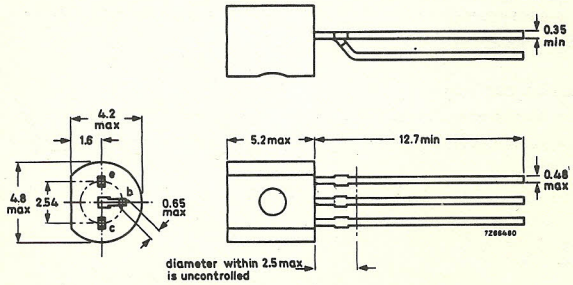
P-N-P transistors in a plastic TO-92 variant primarily intended for use in driver and output stages of audio amplifiers. N-P-N complements are BC337 and BC338.

QUICK REFERENCE DATA

			BC327	BC328	
Collector-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	50	30	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	25	V
Collector current (peak value)	$-I_{CM}$	max.	1000		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	800		mW
Junction temperature	T_j	max.	150		°C
Transition frequency					
$-I_C$ = 10 mA; $-V_{CE}$ = 5 V; f = 35 MHz	f_T	typ.	100		MHz

MECHANICAL DATA Dimensions in mm

TO-92 variant



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

			BC327	BC328	
Collector-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	50	30	V
Collector-emitter voltage (open base) $-I_C$ = 10 mA	$-V_{CEO}$	max.	45	25	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	V

Currents

Collector current (d.c.)	$-I_C$	max.	500	mA
Collector current (peak value)	$-I_{CM}$	max.	1000	mA
Emitter current (peak value)	I_{EM}	max.	1000	mA
Base current (d.c.)	$-I_B$	max.	100	mA
Base current (peak value)	$-I_{BM}$	max.	200	mA

Power dissipation

Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.	625	mW
up to T_{amb} = 25 °C	P_{tot}	max.	800	mW [1]

Temperatures

Storage temperature	T_{stg}	−65	to	+150	°C
Junction temperature	T_j	max.		150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	0,2	°C/mW
From junction to ambient	$R_{th\ j-a}$	=	0,156	°C/mW [1]

[1]) Transistor mounted on printed circuit board, max. lead length 4 mm, mounting pad for collector lead min. 10 mm x 10 mm.

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Collector cut-off current

I_E = 0; $-V_{CB}$ = 20 V; T_j = 25 °C	$-I_{CBO}$	<	100	nA
I_E = 0; $-V_{CB}$ = 20 V; T_j = 150 °C	$-I_{CBO}$	<	5	μA

Emitter cut-off current

I_C = 0; $-V_{EB}$ = 5 V	$-I_{EBO}$	<	10	μA

Base emitter voltage [1])

$-I_C$ = 500 mA; $-V_{CE}$ = 1 V	$-V_{BE}$	<	1,2	V

Saturation voltage

$-I_C$ = 500 mA; $-I_B$ = 50 mA	$-V_{CEsat}$	<	700	mV

D.C. current gain

$-I_C$ = 500 mA; $-V_{CE}$ = 1 V	h_{FE}	>	40	
$-I_C$ = 100 mA; $-V_{CE}$ = 1 V; BC327; BC328	h_{FE}		100 to 600	
BC327-16, BC328-16	h_{FE}		100 to 250	
BC327-25, BC328-25	h_{FE}		160 to 400	

Transition frequency at f = 35 MHz

$-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	typ.	100	MHz

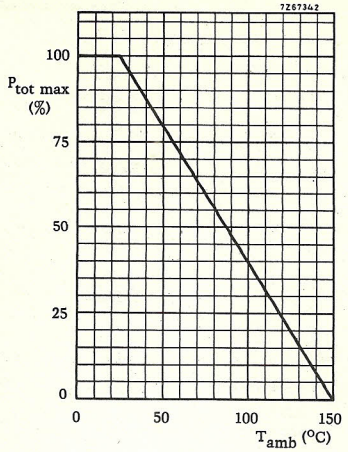
Collector capacitance at f = 1 MHz

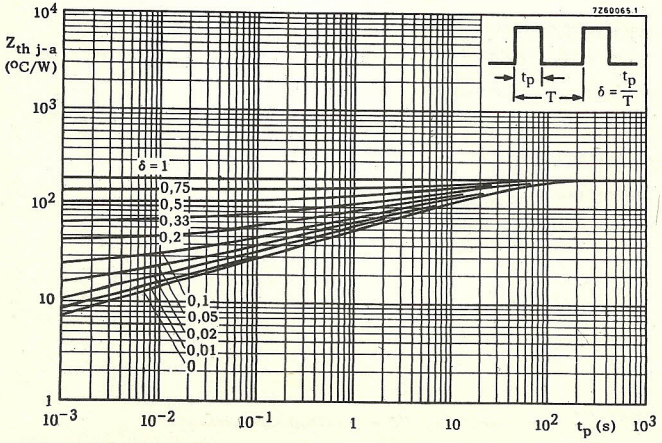
$I_E = I_e$ = 0; $-V_{CB}$ = 10 V	C_c	typ.	8	pF

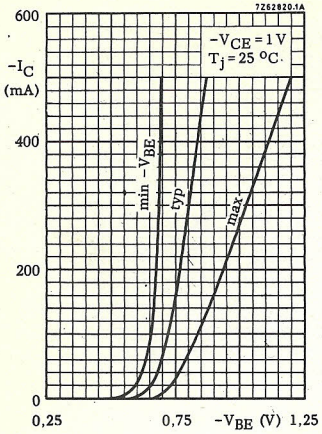
D.C. current gain ratio of matched pair BC327/BC337, BC328/BC338

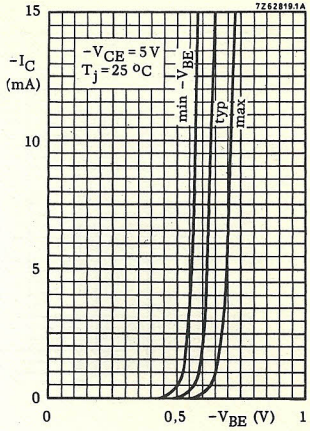
$\lvert I_C \rvert$ = 100 mA; $\lvert V_{CE} \rvert$ = 1 V	h_{FE1}/h_{FE2}	typ.	1,25	
		<	1,40	

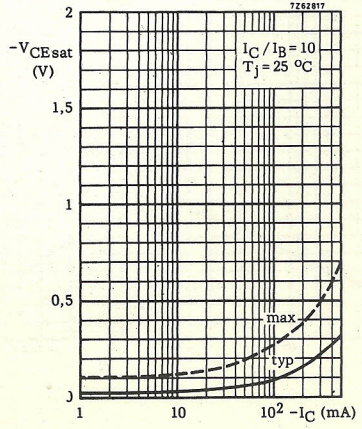
1) $-V_{BE}$ decreases by about 2 mV/°C with increasing temperature.

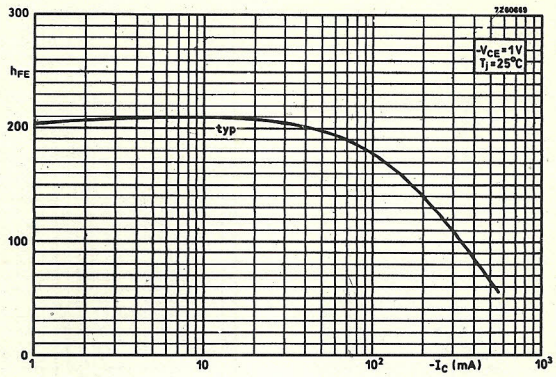

7Z67342
100
$P_{tot\ max}$
(%)
75
50
25
0
0
50
100
150
T_{amb} (°C)

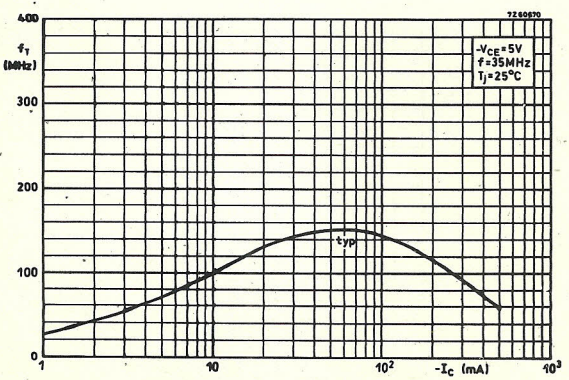

7Z60065.1
10^4
$Z_{th\ j-a}$
(°C/W)
10^3
10^2
10
1
t_p
T
$\delta = \frac{t_p}{T}$
δ = 1
0,75
0,5
0,33
0,2
0,1
0,05
0,02
0,01
0
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
t_p (s)
10^3


7Z62820.1A
600
$-I_C$
(mA)
400
200
0
$-V_{CE}$ = 1 V
T_j = 25 °C
min
$-V_{BE}$
typ
max
0,25
0,75
$-V_{BE}$ (V)
1,25


7Z62819.1A
15
$-I_C$
(mA)
10
5
0
$-V_{CE}$ = 5 V
T_j = 25 °C
min
$-V_{BE}$
typ
max
0
0,5
$-V_{BE}$ (V)
1


7Z62817
2
$-V_{CEsat}$
(V)
1,5
1
0,5
0
I_C / I_B = 10
T_j = 25 °C
max
typ
1
10
10^2
$-I_C$ (mA)





A.F. SILICON PLANAR EPITAXIAL TRANSISTORS

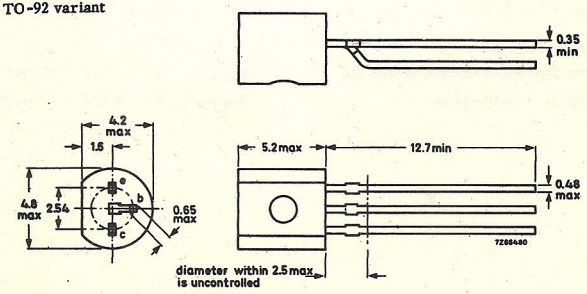
N-P-N transistors in plastic TO-92 variant primarily intended for use in driver and output stages of audio amplifiers. P-N-P complements are BC327 and BC328.

QUICK REFERENCE DATA

			BC337	BC338	
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	50	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	25	V
Collector current (peak value)	I_{CM}	max.	1000		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	800		mW
Junction temperature	T_j	max.	150		°C
Transition frequency					
I_C = 10 mA; V_{CE} = 5 V; f = 35 MHz	f_T	typ.	200		MHz

MECHANICAL DATA Dimensions in mm

TO-92 variant



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages			BC337	BC338	
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	50	30	V
Collector-emitter voltage (open base) I_C = 10 mA	V_{CEO}	max.	45	25	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	5	V

Currents				
Collector current (d.c.)	I_C	max.	500	mA
Collector current (peak value)	I_{CM}	max.	1000	mA
Emitter current (peak value)	$-I_{EM}$	max.	1000	mA
Base current (d.c.)	I_B	max.	100	mA
Base current (peak value)	I_{BM}	max.	200	mA

Power dissipation				
Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.	625	mW
up to T_{amb} = 25 °C	P_{tot}	max.	800	mW [1]

Temperatures				
Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

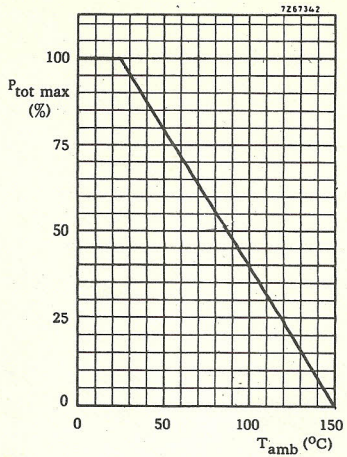
From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0,2	°C/mW
From junction to ambient	$R_{th\ j\text{-}a}$	=	0,156	°C/mW [1]

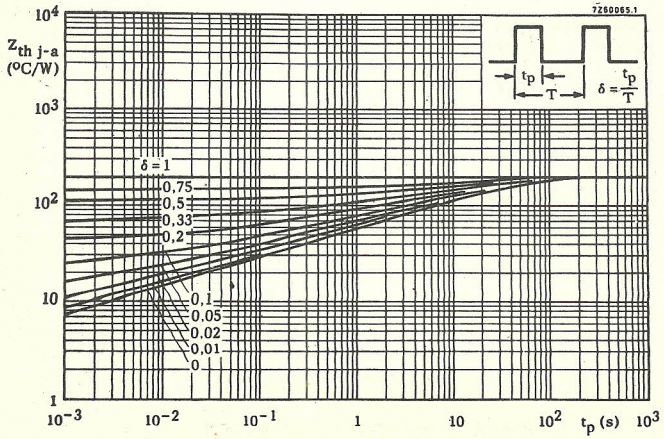
1) Transistor mounted on printed circuit board, max. lead length 4 mm, mounting pad for collector lead min. 10 mm x 10 mm.

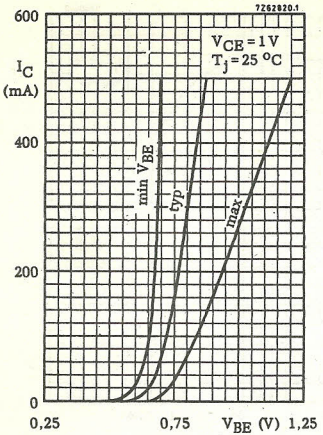
CHARACTERISTICS T_j = 25 °C unless otherwise specified

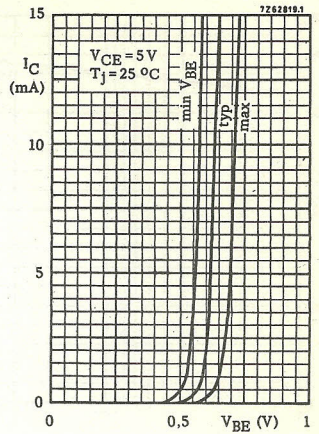
Collector cut-off current				
I_E = 0; V_{CB} = 20 V; T_j = 25 °C	I_{CBO}	<	100	nA
I_E = 0; V_{CB} = 20 V; T_j = 150 °C	I_{CBO}	<	5	µA
Emitter cut-off current				
I_C = 0; V_{EB} = 5 V	I_{EBO}	<	10	µA
Base emitter voltage [1]				
I_C = 500 mA; V_{CE} = 1 V	V_{BE}	<	1,2	V
Saturation voltage				
I_C = 500 mA; I_B = 50 mA	V_{CEsat}	<	700	mV
D.C. current gain				
I_C = 500 mA; V_{CE} = 1 V	h_{FE}	>	40	
I_C = 100 mA; V_{CE} = 1 V; BC337; BC338	h_{FE}		100 to 600	
BC337-16, BC338-16	h_{FE}		100 to 250	
BC337-25, BC338-25	h_{FE}		160 to 400	
Transition frequency at f = 35 MHz				
I_C = 10 mA; V_{CE} = 5 V	f_T	typ.	200	MHz
Collector capacitance at f = 1 MHz				
$I_E = I_e$ = 0; V_{CB} = 10 V	C_c	typ.	5	pF
D.C. current gain ratio of				
matched pair BC337/BC327, BC338/BC328				
$\lvert I_C \rvert$ = 100 mA; $\lvert V_{CE} \rvert$ = 1 V	h_{FE1}/h_{FE2}	typ.	1,25	
		<	1,40	

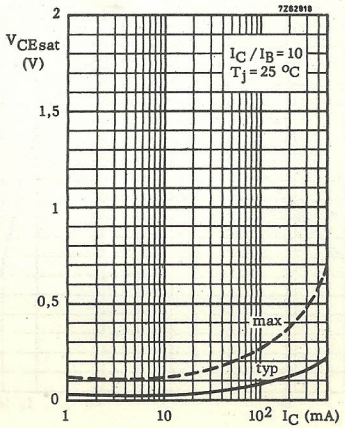
1) V_{BE} decreases by about 2 mV/°C with increasing temperature.

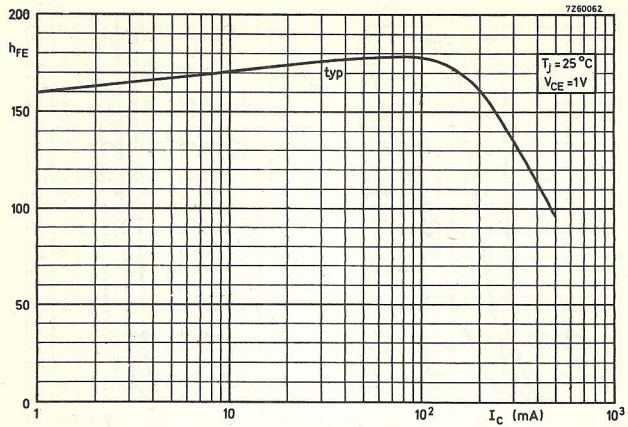

7Z67342
$P_{tot\ max}$ (%)
100
75
50
25
0
0
50
100
150
T_{amb} (°C)

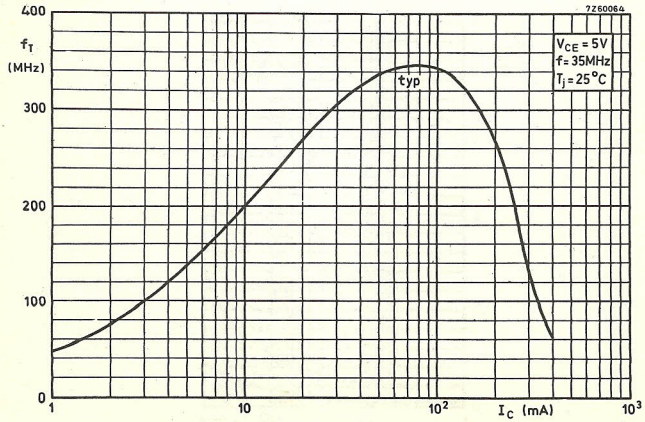

7Z60065.1
$Z_{th\ j-a}$ (°C/W)
10^4
10^3
10^2
10
1
$\delta = 1$
0,75
0,5
0,33
0,2
0,1
0,05
0,02
0,01
0
t_p
T
$\delta = \frac{t_p}{T}$
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
t_p (s)
10^3


7Z62820.1
I_C (mA)
600
400
200
0
$V_{CE} = 1$ V
$T_j = 25$ °C
min V_{BE}
typ
max
0,25
0,75
V_{BE} (V)
1,25


7Z62819.1
I_C (mA)
15
10
5
0
$V_{CE} = 5$ V
$T_j = 25$ °C
min V_{BE}
typ
max
0
0,5
V_{BE} (V)
1


7Z62918
V_{CEsat} (V)
2
1,5
1
0,5
0
$I_C / I_B = 10$
$T_j = 25$ °C
max
typ
1
10
10^2
I_C (mA)





APPLICATION INFORMATION SEE BC327; BC328

A.F. SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistor in a plastic TO-92 variant, especially suitable for use in driver stages of audio amplifiers (BC546 to BC548) and low-noise input stages in tape recorders, hi-fi amplifiers and other AF equipment (BC549/550).

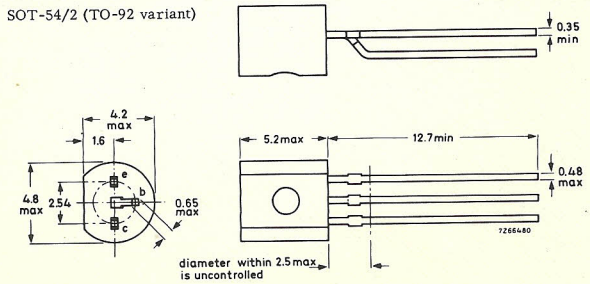
QUICK REFERENCE DATA

			BC546	BC547	BC548	BC549	BC550
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	80	50	30	30	50 V
Collector-emitter voltage (open base)	V_{CEO}	max.	65	45	30	30	45 V
Collector-current (peak value)	I_{CM}	max.	200	200	200	200	200 mA
Total power dissipation up to T_{amb} = 25°C	P_{tot}	max.	500	500	500	500	500 mW
Junction temperature	T_j	max.	150	150	150	150	150 °C
Small signal current gain I_C = 2mA; V_{CE} = 5V; f = 1kHz	h_{fe}	>	125	125	125	240	240
		<	500	900	900	900	900
Transition frequency I_C = 10mA; V_{CE} = 5 V	f_T	typ.	300	300	300	300	300 MHz
Noise figure at R_S = 2 kΩ I_C = 200 µA; V_{CE} = 5 V f = 30 Hz to 15 kHz	F	typ.				1,4	1,4 dB
		max.				4	3 dB
f = 1 kHz; B = 200 Hz	F	typ.	2	2	2	1,2	1 dB
f = 10 - 50 Hz (equivalent noise voltage)	V_n	<				-	0,135 µV

MECHANICAL DATA

Dimensions in mm

SOT-54/2 (TO-92 variant)



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BC546	BC547	BC548	BC549	BC550	
Voltage								
Collector-base voltage (open emitter)	V_{CBO}	max.	80	50	30	30	50	V
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	80	50	30	30	50	V
Collector-emitter voltage (open base)	V_{CEO}	max.	65	45	30	30	45	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6	6	5	5	5	V

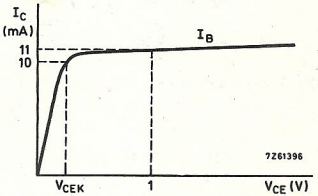
Current				
Collector current (d.c.)	I_C	max.	100	mA
Collector current (peak value)	I_{CM}	max.	200	mA
Emitter current (peak value)	$-I_{EM}$	max.	200	mA
Base current (peak value)	I_{BM}	max.	200	mA
Power dissipation				
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	mW
Temperature				
Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0,25	°C/mW
From junction to case	$R_{th\ j\text{-}e}$	=	0,15	°C/mW

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Collector cut-off current				
I_E = 0; V_{CB} = 30 V	I_{CBO}	<	15	nA
I_E = 0; V_{CB} = 30 V; T_j = 150 °C	I_{CBO}	<	5	μA
Base-emitter voltage 1)				
I_C = 2 mA; V_{CE} = 5 V	V_{BE}	typ.	660	mV
			580 to 700	mV
I_C = 10 mA; V_{CE} = 5 V	V_{BE}	<	770	mV
Saturation voltage 2)				
I_C = 10 mA; I_B = 0.5 mA	V_{CEsat}	typ.	90	mV
		<	250	mV
	V_{BEsat}	typ.	700	mV
I_C = 100 mA; I_B = 5 mA	V_{CEsat}	typ.	200	mV
		<	600	mV
	V_{BEsat}	typ.	900	mV
Knee voltage				
I_C = 10 mA; I_B = value for which I_C = 11 mA at V_{CE} = 1 V	V_{CEK}	typ.	300	mV
		<	600	mV



Collector capacitance at f = 1 MHz				
$I_E = I_e$ = 0; V_{CB} = 10 V	C_c	typ.	2,5	pF
		<	4,5	pF
Emitter capacitance at f = 1 MHz				
$I_C = I_c$ = 0; V_{EB} = 0,5 V	C_e	typ.	9	pF
Transition frequency at f = 35 MHz				
I_C = 10 mA; V_{CE} = 5 V	f_T	typ.	300	MHz

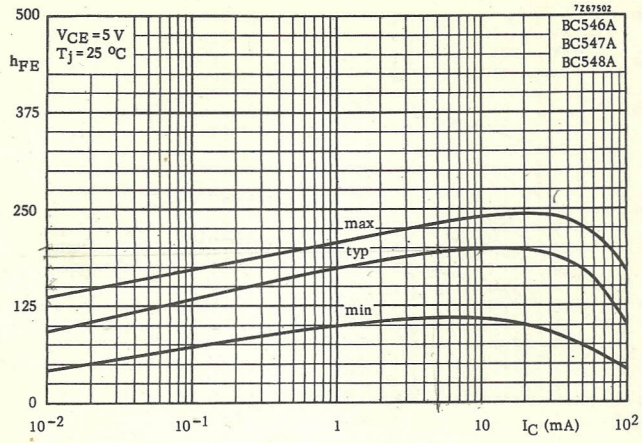
1) V_{BE} decreases by about 2 mV/°C with increasing temperature.
2) V_{BEsat} decreases by about 1,7 mV/°C with increasing temperature.

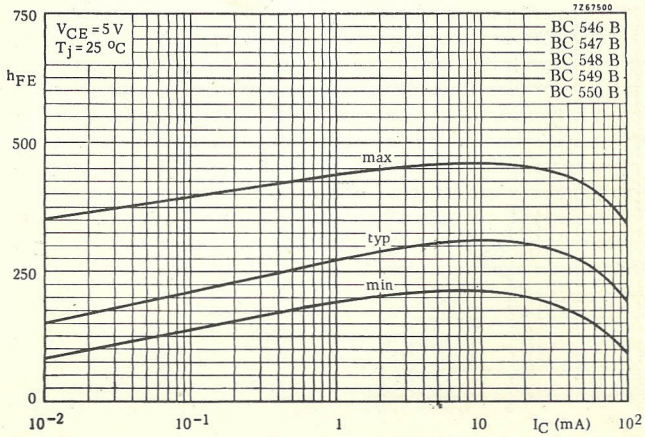
CHARACTERISTICS (continued)

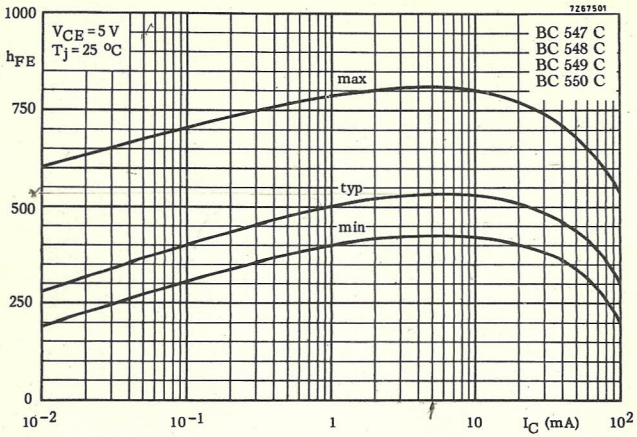
T_j = 25°C unless otherwise specified

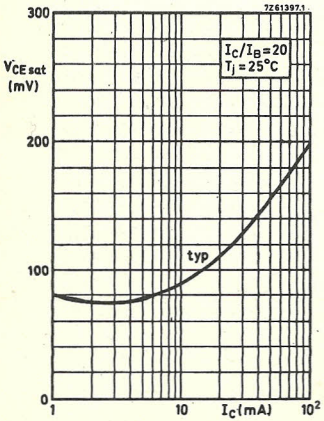
			BC546	BC547	BC548	BC549	BC550	
Small signal current gain at f = 1 kHz								
I_C = 2 mA; V_{CE} = 5 V	h_{fe}	>	125	125	125	240	240	
		<	500	900	900	900	900	
Noise figure at R_S = 2 kΩ								
I_C = 200 µA; V_{CE} = 5 V								
f = 30 Hz to 15 kHz	F	typ.				1,4	1,4	dB
		<				4	3	dB
f = 1 kHz; B = 200 Hz	F	typ.	2	2	2	1,2	1	dB
		<	10	10	10	4	4	dB
Equivalent noise voltage at R_S = 2 kΩ								
I_C = 200 µA; V_{CE} = 5 V								
f = 10 Hz to 50 Hz; T_{amb} = 25°C	V_n	max.				-	0,135	µV

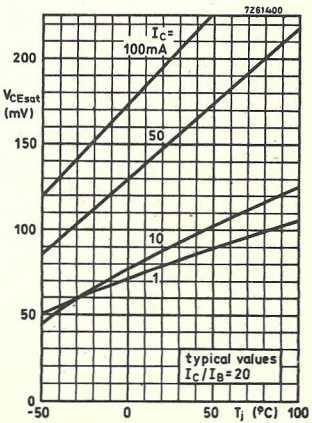
			BC546A BC547A BC548A	BC546B BC547B BC548B BC549B BC550B	BC547C BC548C BC549C BC550C	
D.C. current gain						
I_C = 10 µA; V_{CE} = 5 V	h_{FE}	typ.	90	150	270	
		>	110	200	420	
I_C = 2 mA; V_{CE} = 5 V	h_{FE}	typ.	180	290	520	
		<	220	450	800	
h parameters at f = 1 kHz (common emitter)						
I_C = 2 mA; V_{CE} = 5 V						
		>	1,6	3,2	6	kΩ
Input impedance	h_{ie}	typ.	2,7	4,5	8,7	kΩ
		<	4,5	8,5	15	kΩ
Reverse voltage transfer ratio	h_{re}	typ.	1,5	2	3	10^{-4}
		>	125	240	450	
Small signal current gain	h_{fe}	typ.	220	330	600	
		<	260	500	900	
		typ.	18	30	60	µA/V
Output admittance		<	30	60	110	µA/V

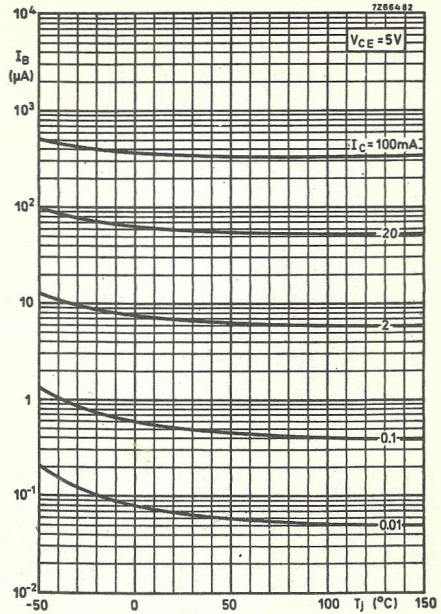




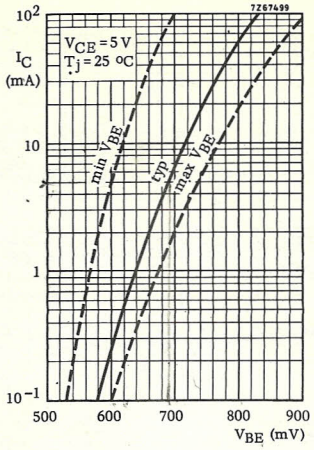


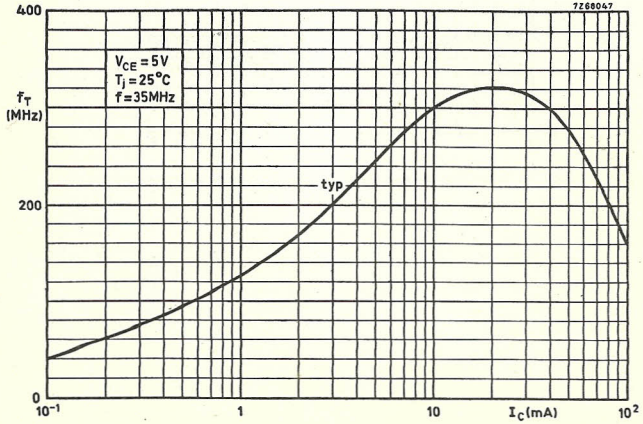


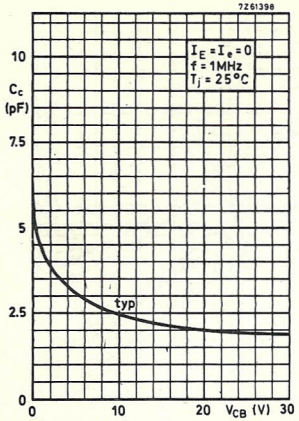


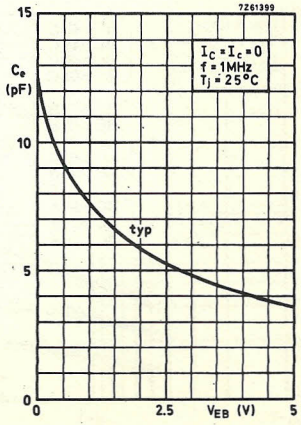


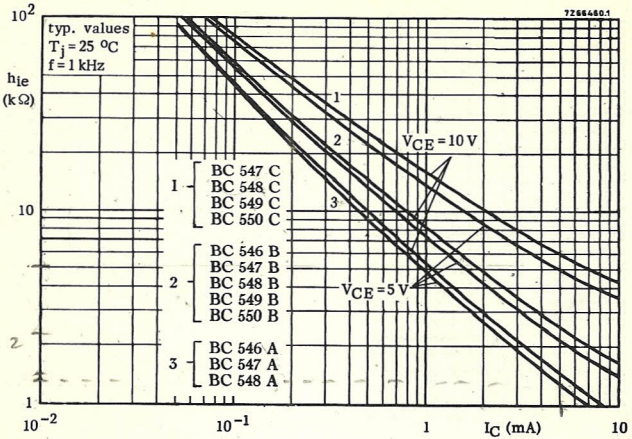
Typical behaviour of base current versus junction temperature

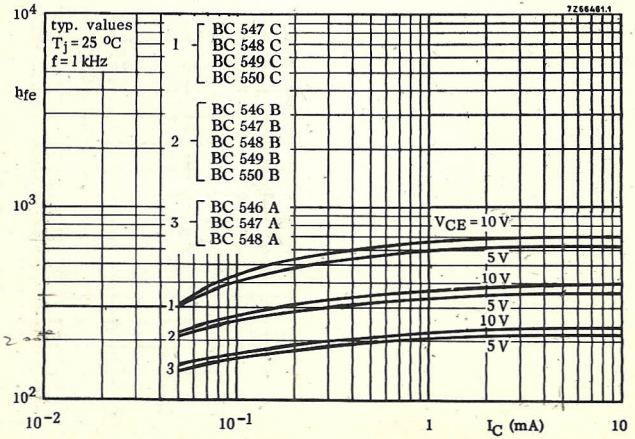

7Z67499
V_{CE} = 5 V
T_j = 25 °C
I_C
(mA)
10^2
10
1
10^{-1}
min V_{BE}
typ
max V_{BE}
500
600
700
800
900
V_{BE} (mV)

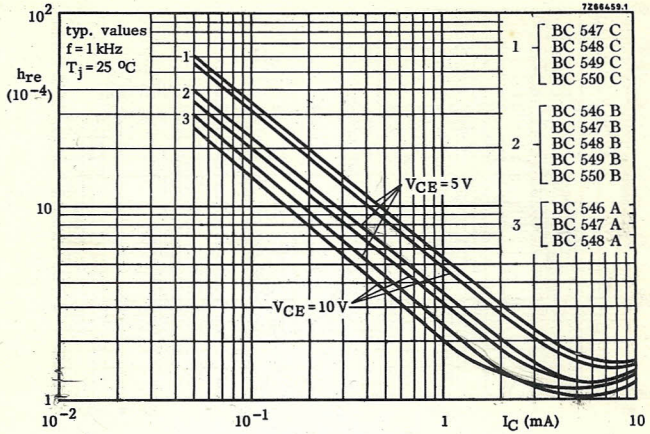

7Z68047
V_{CE} = 5 V
T_j = 25 °C
f = 35 MHz
f_T
(MHz)
400
200
0
typ
10^{-1}
1
10
I_C (mA)
10^2

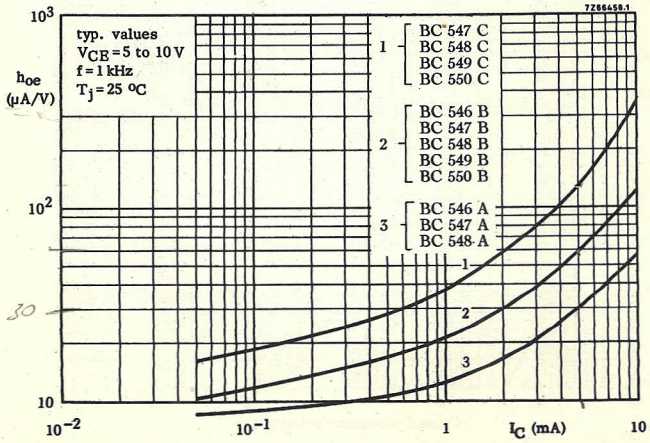

7Z61398
$I_E = I_e = 0$
f = 1 MHz
T_j = 25 °C
C_c
(pF)
10
7.5
5
2.5
0
typ
0
10
20
V_{CB} (V)
30

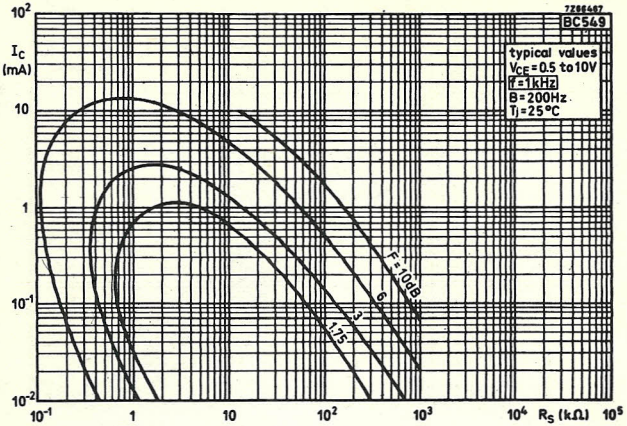

7Z61399
$I_C = I_c = 0$
f = 1 MHz
T_j = 25 °C
C_e
(pF)
15
10
5
0
typ
0
2.5
V_{EB} (V)
5


7Z66460.1
typ. values
T_j = 25 °C
f = 1 kHz
h_{ie}
(kΩ)
10^2
10
1
10^{-2}
10^{-1}
1
10
I_C (mA)
V_{CE} = 10 V
V_{CE} = 5 V
1
2
3
1 BC 547 C
BC 548 C
BC 549 C
BC 550 C
2 BC 546 B
BC 547 B
BC 548 B
BC 549 B
BC 550 B
3 BC 546 A
BC 547 A
BC 548 A

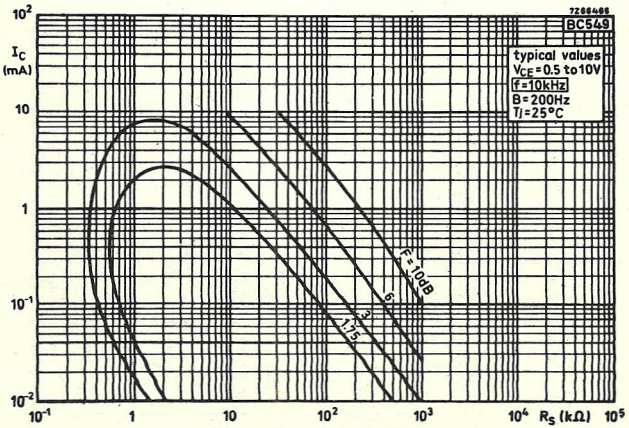

7Z66461.1
typ. values
T_j = 25 °C
f = 1 kHz
h_{fe}
10^4
10^3
10^2
10^{-2}
10^{-1}
1
10
I_C (mA)
1 BC 547 C
BC 548 C
BC 549 C
BC 550 C
2 BC 546 B
BC 547 B
BC 548 B
BC 549 B
BC 550 B
3 BC 546 A
BC 547 A
BC 548 A
V_{CE} = 10 V
5 V
10 V
5 V
10 V
5 V
1
2
3


7Z66459.1
typ. values
f = 1 kHz
T_j = 25 °C
h_{re}
(10^{-4})
10^2
10
1
10^{-2}
10^{-1}
1
10
I_C (mA)
1
2
3
V_{CE} = 5 V
V_{CE} = 10 V
1 BC 547 C
BC 548 C
BC 549 C
BC 550 C
2 BC 546 B
BC 547 B
BC 548 B
BC 549 B
BC 550 B
3 BC 546 A
BC 547 A
BC 548 A

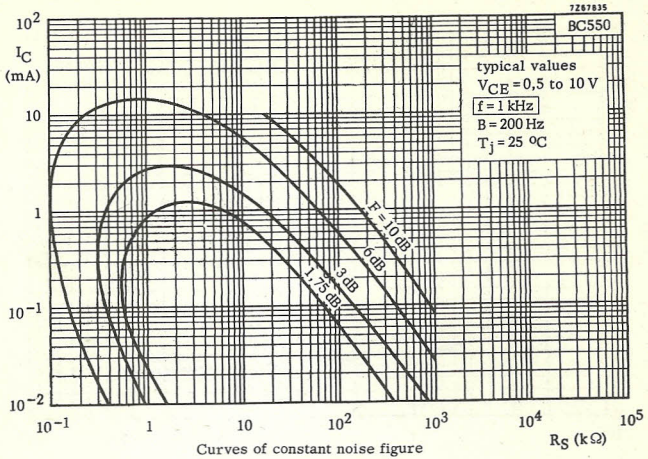

7Z66458.1
typ. values
V_{CE} = 5 to 10 V
f = 1 kHz
T_j = 25 °C
h_{oe}
(μA/V)
10^3
10^2
10
10^{-2}
10^{-1}
1
10
I_C (mA)
1 BC 547 C
BC 548 C
BC 549 C
BC 550 C
2 BC 546 B
BC 547 B
BC 548 B
BC 549 B
BC 550 B
3 BC 546 A
BC 547 A
BC 548 A
1
2
3



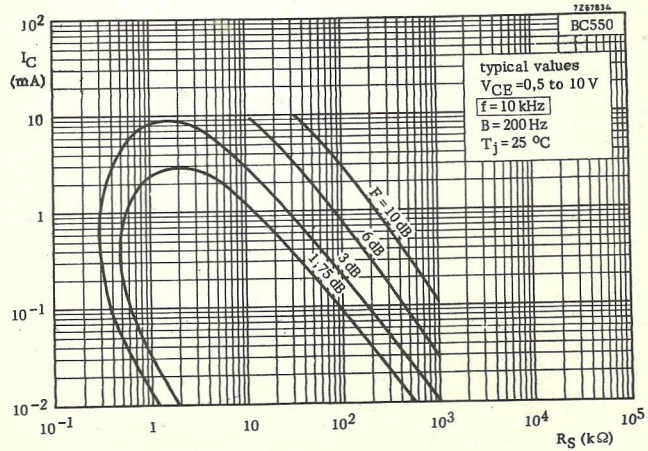
Curves of constant noise figure



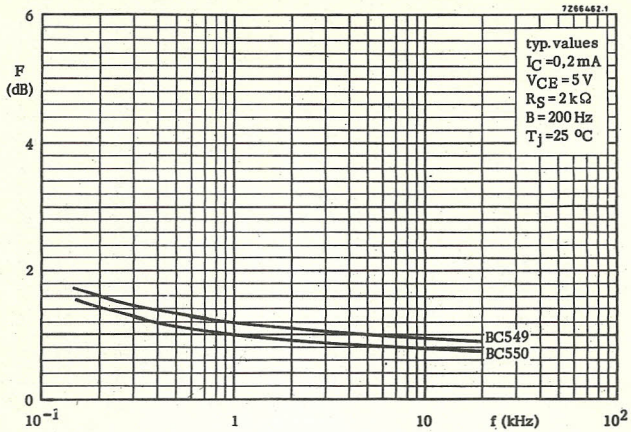
Curves of constant noise figure



Curves of constant noise figure



Curves of constant noise figure



A.F. SILICON PLANAR EPITAXIAL TRANSISTORS

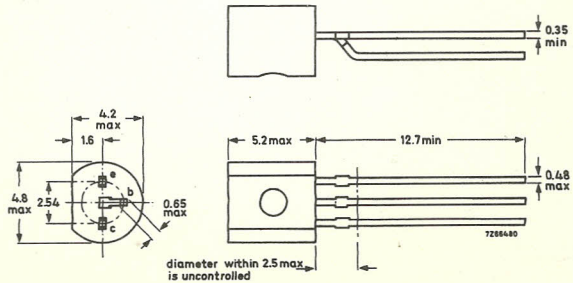
General purpose p-n-p transistors in a plastic TO-92 variant, especially suitable for use in driver stages of audio amplifiers.
The BC559 is a low noise type for input stages in tape recorders, hi-fi amplifiers and other audio frequency equipment.

QUICK REFERENCE DATA

			BC 556	BC 557	BC 558	BC 559	
Collector-emitter voltage ($+V_{BE}$ = 1 V)	$-V_{CEX}$	max.	80	50	30	30	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	65	45	30	30	V
Collector current (peak value)	$-I_{CM}$	max.	200	200	200	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	500	500	500	mW
Junction temperature	T_j	max.	150	150	150	150	°C
Small signal current gain $-I_C$ = 2 mA; $-V_{CE}$ = 5 V; f = 1 kHz	h_{fe}	>	75	75	75	125	
		<	260	260	500	500	
Transition frequency $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	typ.	150	150	150	150	MHz
Noise figure at R_S = 2 kΩ $-I_C$ = 200 μA; $-V_{CE}$ = 5 V f = 30 Hz to 15 kHz	F	typ.				1,2	dB
		<				4	dB
f = 1 kHz; B = 200 Hz	F	<	10	10	10	4	dB

MECHANICAL DATA Dimensions in mm

TO-92 variant



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages			BC 556	BC 557	BC 558	BC 559	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	80	50	30	30	V
Collector-emitter voltage ($+V_{BE}$ = 1 V)	$-V_{CEX}$	max.	80	50	30	30	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	65	45	30	30	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	5	5	V

Currents				
Collector current (d.c.)	$-I_C$	max.	100	mA
Collector current (peak value)	$-I_{CM}$	max.	200	mA
Emitter current (peak value)	I_{EM}	max.	200	mA
Base current (peak value)	$-I_{BM}$	max.	200	mA

Power dissipation				
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	mW

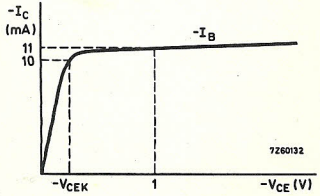
Temperatures				
Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	0,25	°C/mW
From junction to case	$R_{th\ j-c}$	=	0,15	°C/mW

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Collector cut-off current				
I_E = 0; $-V_{CB}$ = 20 V ; T_j = 25 °C	$-I_{CBO}$	typ.	1	nA
		<	15	nA
T_j = 150 °C	$-I_{CBO}$	<	4	µA
Base-emitter voltage [1]				
$-I_C$ = 2 mA; $-V_{CE}$ = 5 V	$-V_{BE}$	typ.	650	mV
			600 to 750	mV
$-I_C$ = 10 mA; $-V_{CE}$ = 5 V	$-V_{BE}$	<	820	mV
Saturation voltages [2]				
$-I_C$ = 10 mA; $-I_B$ = 0,5 mA	$-V_{CEsat}$	typ.	75	mV
		<	300	mV
	$-V_{BEsat}$	typ.	700	mV
$-I_C$ = 100 mA; $-I_B$ = 5 mA	$-V_{CEsat}$	typ.	250	mV
		<	650	mV
	$-V_{BEsat}$	typ.	850	mV
Knee voltage				
$-I_C$ = 10 mA; $-I_B$ = value for which $-I_C$ = 11 mA at $-V_{CE}$ = 1 V	$-V_{CEK}$	typ.	250	mV
		<	600	mV

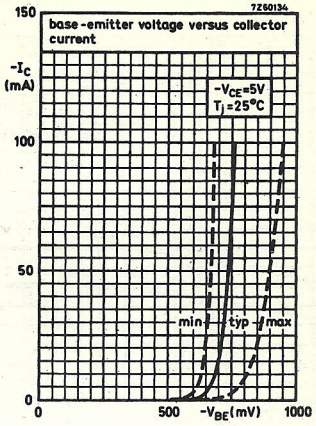


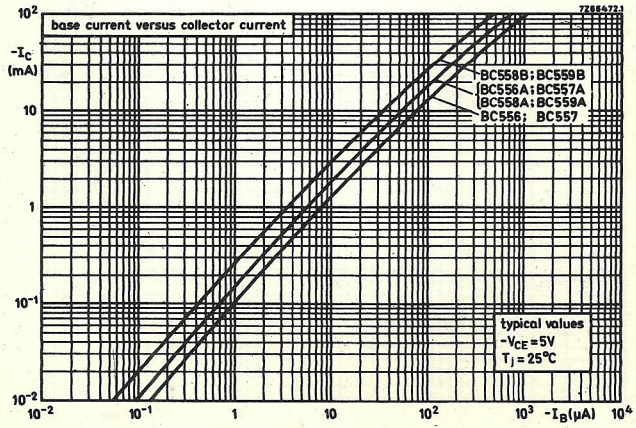
Collector capacitance at f = 1 MHz				
$I_E = I_e$ = 0; $-V_{CB}$ = 10 V	C_c	typ.	4,5	pF
Transition frequency at f = 35 MHz				
$-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	typ.	150	MHz

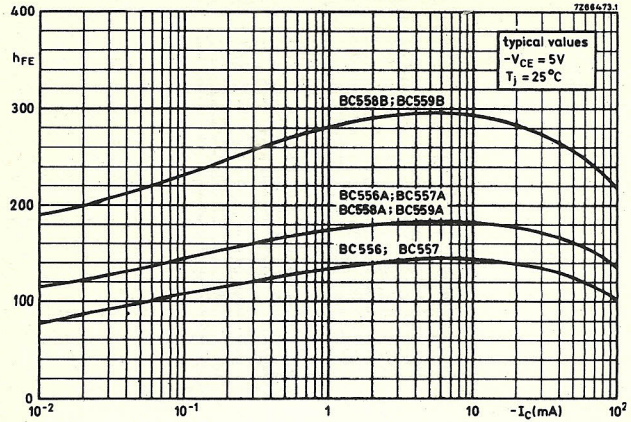
1) $-V_{BE}$ decreases by about 2 mV/°C with increasing temperature.
2) $-V_{BEsat}$ decreases by about 1,7 mV/°C with increasing temperature.

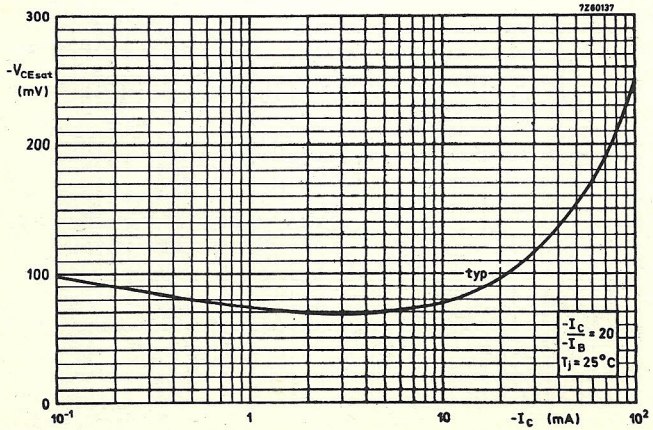
CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

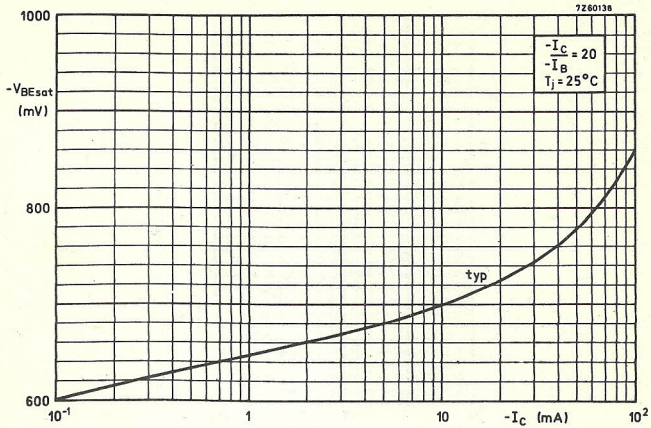
			BC556 BC557	BC558	BC559	
Small signal current gain at f = 1 kHz						
$-I_C$ = 2 mA; $-V_{CE}$ = 5 V	h_{fe}	>	75	75	125	
		<	260	500	500	
Noise figure at R_S = 2 kΩ						
$-I_C$ = 200 μA; $-V_{CE}$ = 5 V						
f = 30 Hz to 15 kHz	F	typ.			1, 2	dB
		<			4	dB
f = 1 kHz; B = 200 Hz	F	typ.	2	2	1	dB
		<	10	10	4	dB
				BC556A BC557A		
D.C. current gain			BC556 BC557	BC558A BC559A	BC558B BC559B	
$-I_C$ = 2 mA; $-V_{CE}$ = 5 V	h_{FE}	>	75	125	220	
		typ.	140	180	290	
		<	250	250	475	

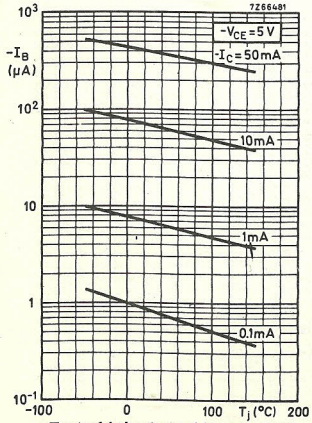




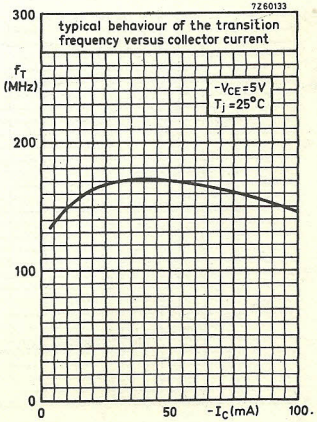


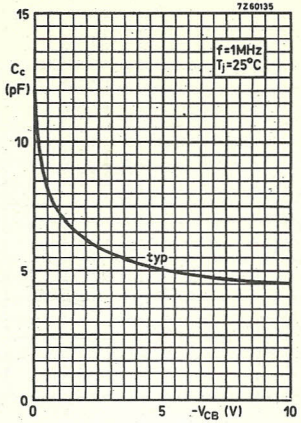


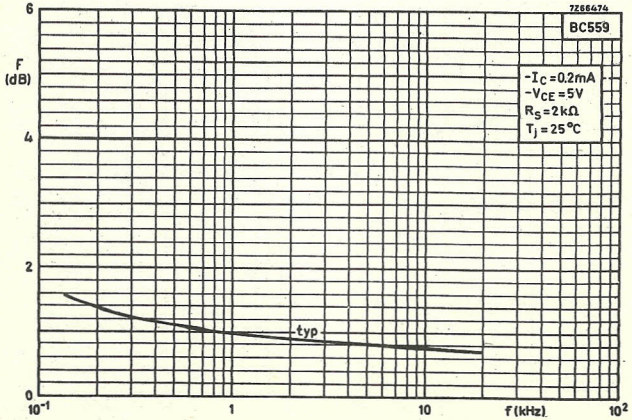


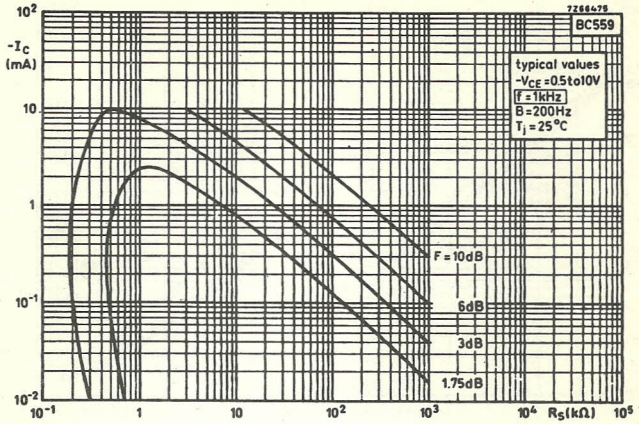


Typical behaviour of base current versus junction temperature

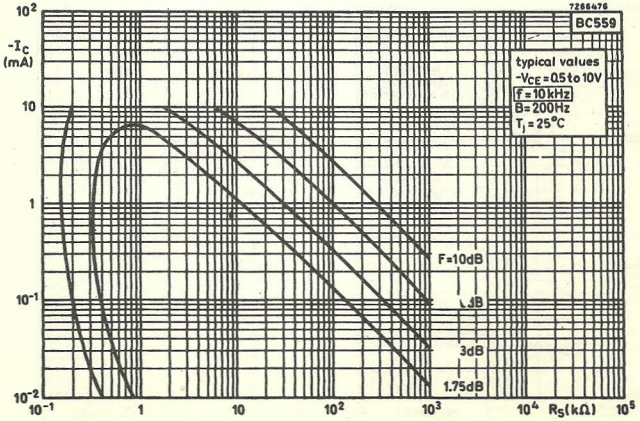




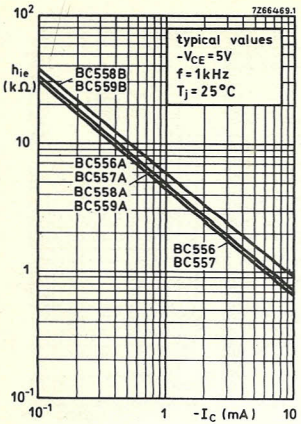


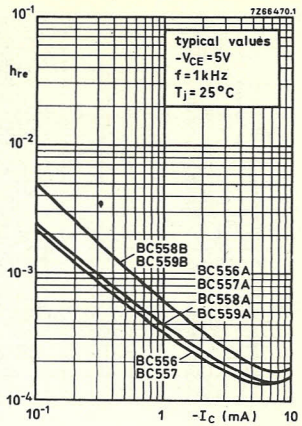


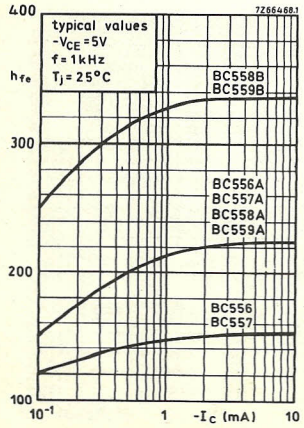
Curves of constant noise figure

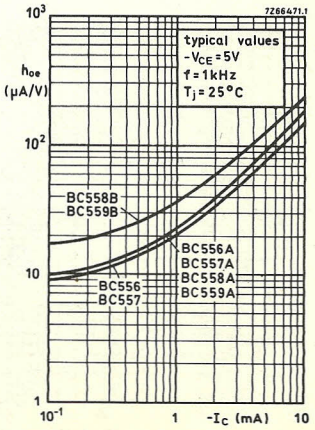


Curves of constant noise figure









SILICON PLANAR EPITAXIAL TRANSISTORS

General purpose n-p-n transistors in SOT-32 plastic envelope, recommended for driver stages in hi-fi amplifiers and television circuits.
The BD136, BD138 and BD140 are complementary to the BD135, BD137 and BD139 respectively.

QUICK REFERENCE DATA

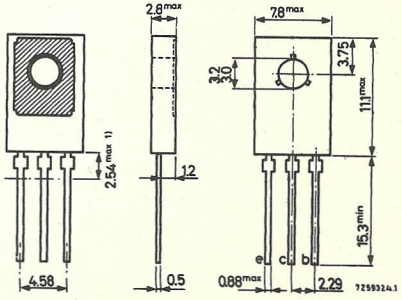
			BD135	BD137	BD139	
Collector-base voltage (open emitter)	V_{CBO}	max.	45	60	100	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	V_{CER}	max.	45	60	100	V
Collector-current (peak value)	I_{CM}	max.	1,5	1,5	1,5	A
Total power dissipation up to T_{mb} = 70 °C	P_{tot}	max.	8	8	8	W
Junction temperature	T_j	max.	150	150	150	°C
D.C. current gain						
I_C = 150 mA; V_{CE} = 2 V	h_{FE}	>	40	40	40	
		<	250	160	160	
Transition frequency at f = 35 MHz						
I_C = 50 mA; V_{CE} = 5 V	f_T	typ.	250	250	250	MHz

MECHANICAL DATA

Dimensions in mm

SOT-32 (TO-126)

Collector connected to metal part of mounting surface



For mounting instructions see Accessories type 56326 for non-insulated mounting and type 56333 for insulated mounting.

1) Within this region the cross-section of the leads is uncontrolled.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

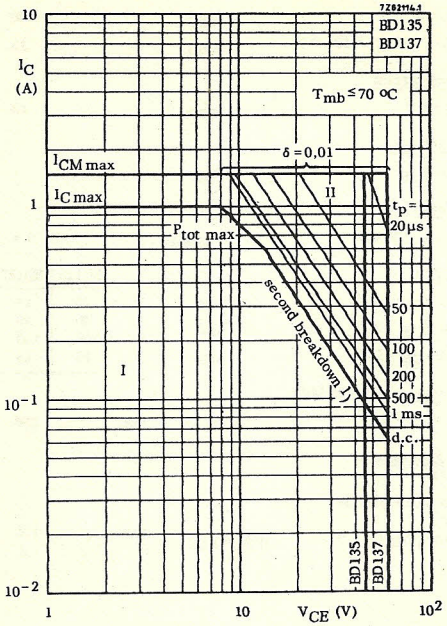
Voltages			BD135	BD137	BD139	
Collector-base voltage (open emitter)	V_{CBO}	max.	45	60	100	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	V_{CER}	max.	45	60	100	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	5	5	V
Currents						
Collector current (d.c.)	I_C	max.	1,0	1,0	1,0	A
Collector current (peak value)	I_{CM}	max.	1,5	1,5	1,5	A
Power dissipation						
Total power dissipation up to T_{mb} = 70 °C	P_{tot}			max.	8	W
Temperatures						
Storage temperature	T_{stg}			−55 to +150		°C
Junction temperature	T_j			max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	100	°C/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	10	°C/W

CHARACTERISTICS T_j = 25 °C unless otherwise specified

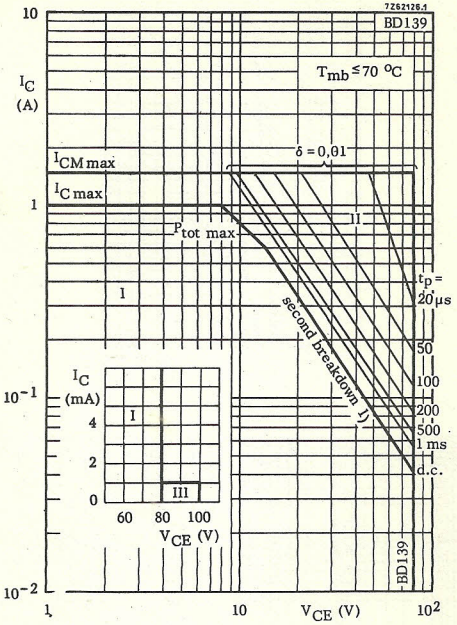
Collector cut-off current					
I_E = 0; V_{CB} = 30 V	I_{CBO}	<		100	nA
I_E = 0; V_{CB} = 30 V; T_j = 125 °C	I_{CBO}	<		10	μA
Emitter cut-off current					
I_C = 0; V_{EB} = 5 V	I_{EBO}	<		10	μA
Base emitter voltage					
I_C = 500 mA; V_{CE} = 2 V	V_{BE}	<		1	V
Saturation voltage					
I_C = 500 mA; I_B = 50 mA	V_{CEsat}	<		0,5	V
D.C. current gain			BD135	BD137	BD139
I_C = 5 mA; V_{CE} = 2 V	h_{FE}	>	25	25	25
I_C = 150 mA; V_{CE} = 2 V	h_{FE}	>	40	40	40
		<	250	160	160
I_C = 500 mA; V_{CE} = 2 V	h_{FE}	>	25	25	25
Transition frequency at f = 35 MHz					
I_C = 50 mA; V_{CE} = 5 V	f_T	typ.		250	MHz
D.C. current gain ratio of matched pairs					
BD135/BD136; BD137/BD138					
BD139/BD140					
$\lvert I_C \rvert$ = 150 mA; $\lvert V_{CE} \rvert$ = 2 V	h_{FE1}/h_{FE2}	typ		1,3	
		<		1,6	



Safe Operating Area with the transistor forward biased

I Region of permissible d.c. operation
II Permissible extension for repetitive pulse operation

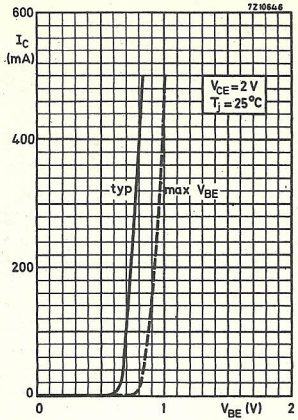
1) Independent of temperature

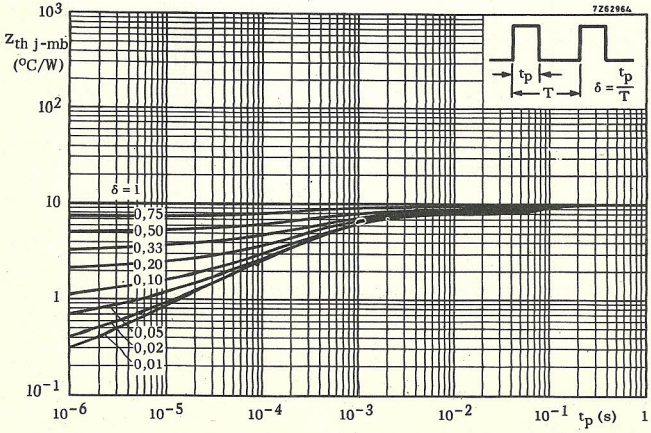


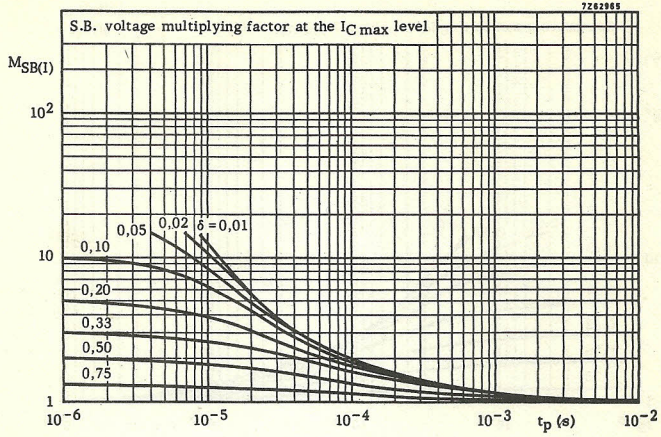
Safe Operating Area with the transistor forward biased

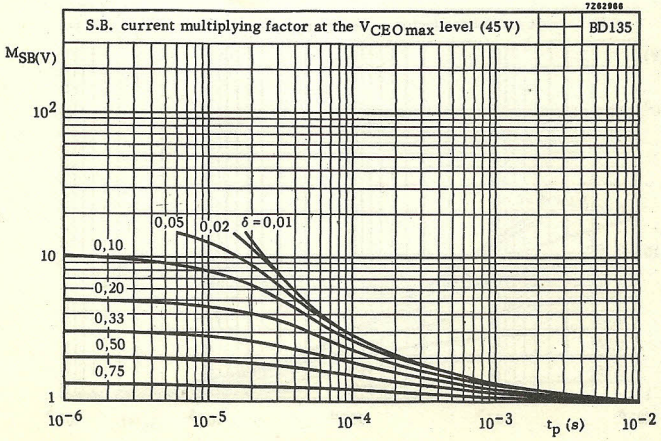
I Region of permissible d.c. operation
II Permissible extension for repetitive pulsed operation
III Repetitive pulse operation in this region is allowable, provided $R_{BE} \leq 1$ kΩ

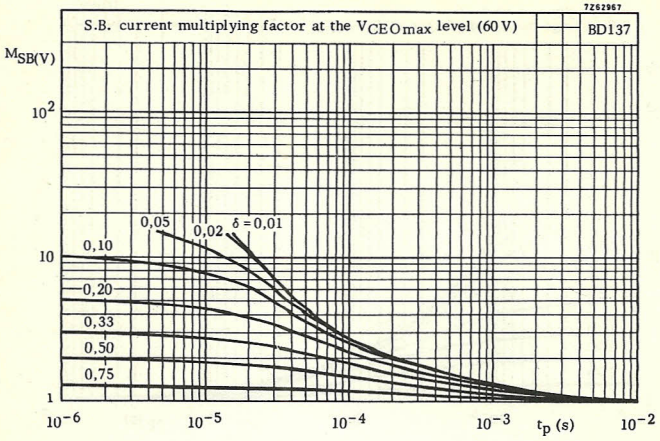
1) Independent of temperature

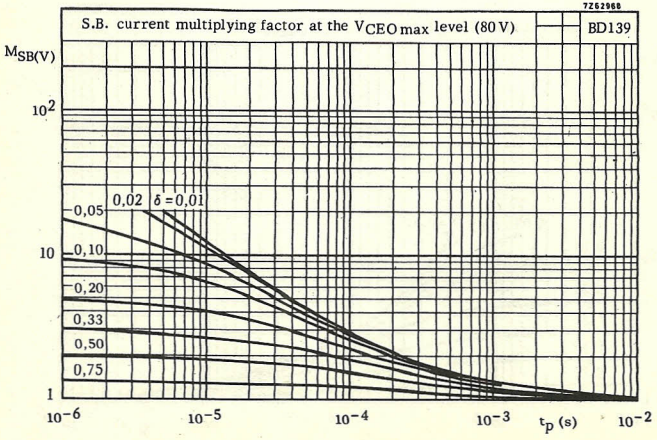

7Z10646
600
I_C
(mA)
400
200
0
0
1
2
V_{BE} (V)
V_{CE} = 2 V
T_j = 25 °C
typ
max V_{BE}

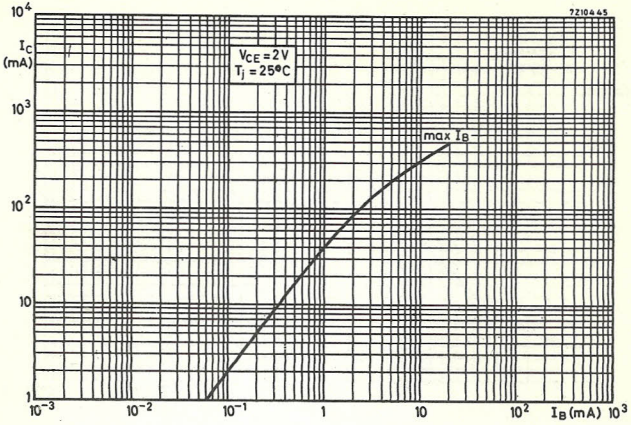

7Z62964
10^3
$Z_{th\ j\text{-}mb}$
(°C/W)
10^2
10
1
10^{-1}
10^{-6}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
t_p (s)
1
t_p
T
$\delta = \frac{t_p}{T}$
δ = 1
0,75
0,50
0,33
0,20
0,10
0,05
0,02
0,01

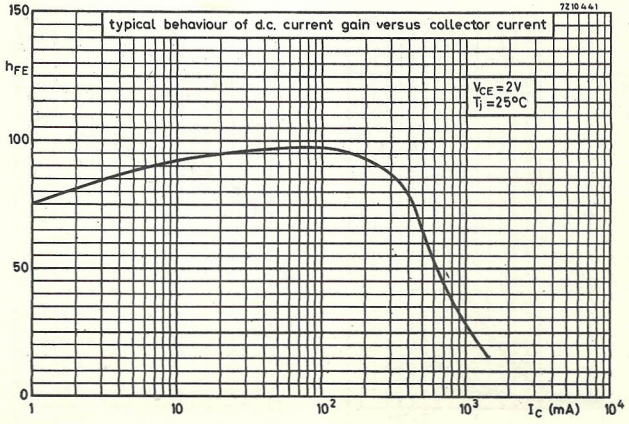

7Z62965
S.B. voltage multiplying factor at the $I_{C\,max}$ level
$M_{SB(I)}$
10^2
10
1
10^{-6}
10^{-5}
10^{-4}
10^{-3}
t_p (s)
10^{-2}
0,10
0,05
0,02
δ = 0,01
0,20
0,33
0,50
0,75

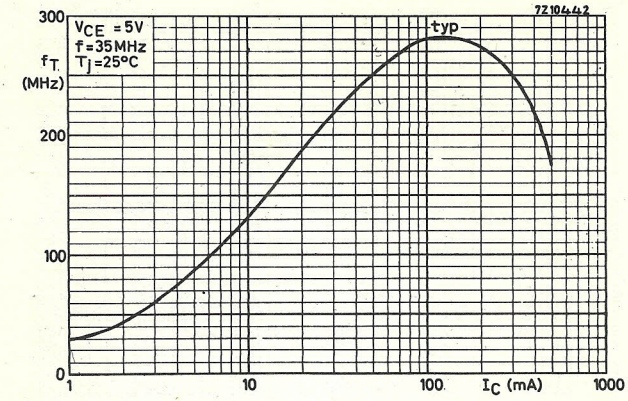

7Z62966
S.B. current multiplying factor at the $V_{CEO\,max}$ level (45 V)
BD135
$M_{SB(V)}$
10^2
10
1
10^{-6}
10^{-5}
10^{-4}
10^{-3}
t_p (s)
10^{-2}
0,10
0,05
0,02
δ = 0,01
0,20
0,33
0,50
0,75

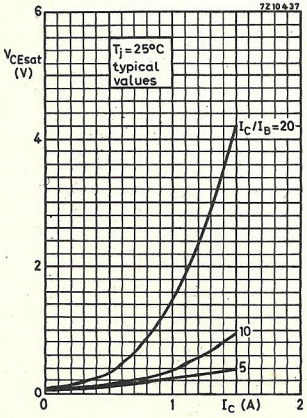

7Z62967
S.B. current multiplying factor at the V_{CEO} max level (60 V)
BD137
$M_{SB(V)}$
10^2
10
1
0,05
0,02
δ = 0,01
0,10
0,20
0,33
0,50
0,75
10^{-6}
10^{-5}
10^{-4}
10^{-3}
t_p (s)
10^{-2}

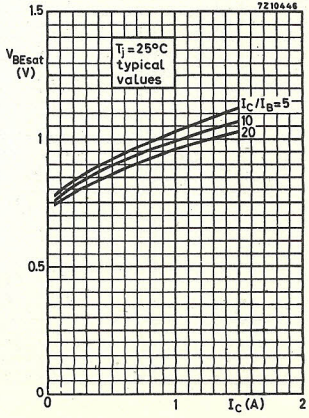

7Z62968
S.B. current multiplying factor at the V_{CEO} max level (80 V)
BD139
$M_{SB(V)}$
10^2
10
1
0,05
0,02
δ = 0,01
0,10
0,20
0,33
0,50
0,75
10^{-6}
10^{-5}
10^{-4}
10^{-3}
t_p (s)
10^{-2}


7Z10445
I_C (mA)
10^4
10^3
10^2
10
1
V_{CE} = 2 V
T_j = 25°C
max I_B
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
I_B (mA)
10^3


7Z10441
typical behaviour of d.c. current gain versus collector current
h_{FE}
150
100
50
0
V_{CE} = 2V
T_j = 25°C
1
10
10^2
10^3
I_C (mA)
10^4







SILICON PLANAR EPITAXIAL TRANSISTORS

General purpose p-n-p transistors in SOT-32 plastic envelope, recommended for driver stages in hi-fi amplifiers and television circuits.
The BD135, BD137 and BD139 are complementary to the BD136, BD138 and BD140 respectively.

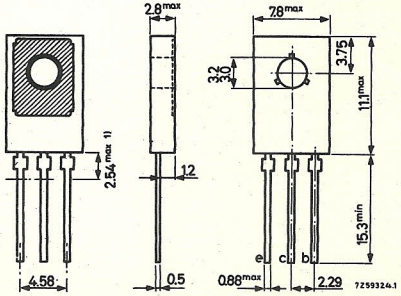
QUICK REFERENCE DATA

			BD136	BD138	BD140	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	45	60	100	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	$-V_{CER}$	max.	45	60	100	V
Collector-current (peak value)	$-I_{CM}$	max.	1,5	1,5	1,5	A
Total power dissipation up to T_{mb} = 70 °C	P_{tot}	max.	8	8	8	W
Junction temperature	T_j	max.	150	150	150	°C
D.C. current gain $-I_C$ = 150 mA; $-V_{CE}$ = 2 V	h_{FE}	>	40	40	40	
		<	250	160	160	
Transition frequency at f = 35 MHz $-I_C$ = 50 mA; $-V_{CE}$ = 5 V	f_T	typ.	75	75	75	MHz

MECHANICAL DATA

Dimensions in mm

SOT-32 (TO-126)
Collector connected to metal part of mounting surface



For mounting instructions see section Accessories type 56326 for non-insulated mounting and type 56333 for insulated mounting.

1) Within this region the cross-section of the leads is uncontrolled.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

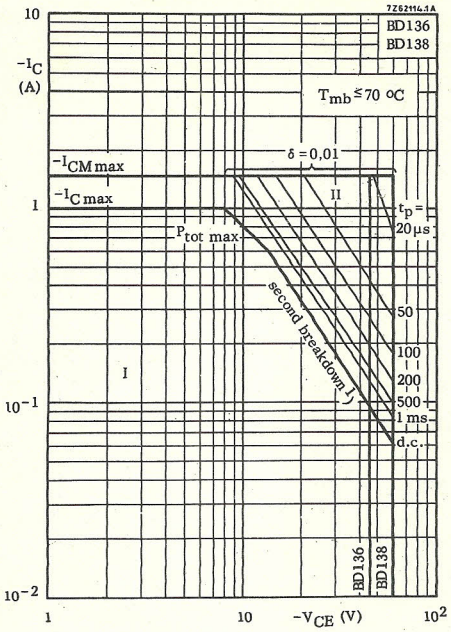
Voltages			BD136	BD138	BD140	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	45	60	100	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	$-V_{CER}$	max.	45	60	100	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	5	V
Currents						
Collector current (d.c.)	$-I_C$	max.	1,0	1,0	1,0	A
Collector current (peak value)	$-I_{CM}$	max.	1,5	1,5	1,5	A
Power dissipation						
Total power dissipation up to T_{mb} = 70 °C	P_{tot}	max.			8	W
Temperatures						
Storage temperature	T_{stg}				−55 to +150	°C
Junction temperature	T_j	max.			150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	100	°C/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	10	°C/W

CHARACTERISTICS T_j = 25 °C unless otherwise specified

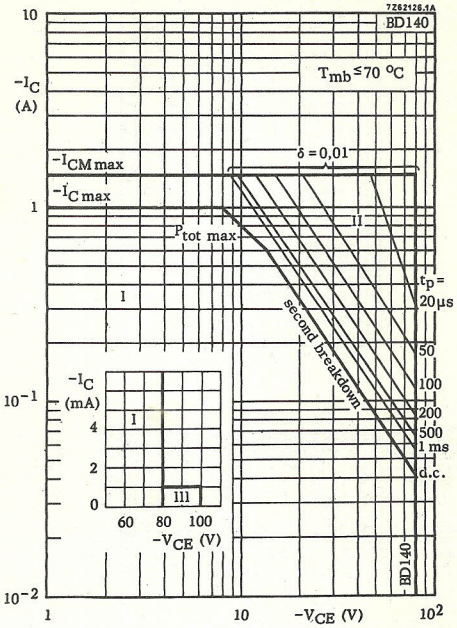
Collector cut-off current						
I_E = 0; $-V_{CB}$ = 30 V	$-I_{CBO}$	<			100	nA
I_E = 0; $-V_{CB}$ = 30 V; T_j = 125 °C	$-I_{CBO}$	<			10	μA
Emitter cut-off current						
I_C = 0; $-V_{EB}$ = 5 V	$-I_{EBO}$	<			10	μA
Base emitter voltage						
$-I_C$ = 500 mA; $-V_{CE}$ = 2 V	$-V_{BE}$	<			1	V
Saturation voltage						
$-I_C$ = 500 mA; $-I_B$ = 50 mA	$-V_{CEsat}$	<			0,5	V
D.C. current gain			BD136	BD138	BD140	
$-I_C$ = 5 mA; $-V_{CE}$ = 2 V	h_{FE}	>	25	25	25	
$-I_C$ = 150 mA; $-V_{CE}$ = 2 V	h_{FE}	>	40	40	40	
		<	250	160	160	
$-I_C$ = 500 mA; $-V_{CE}$ = 2 V	h_{FE}	>	25	25	25	
Transition frequency at f = 35 MHz						
$-I_C$ = 50 mA; $-V_{CE}$ = 5 V	f_T	typ.			75	MHz
D.C. current gain ratio of matched pairs						
BD135/BD136; BD137/BD138						
BD139/BD140						
$\lvert I_C \rvert$ = 150 mA; $\lvert V_{CE} \rvert$ = 2 V	h_{FE1}/h_{FE2}	typ.			1,3	
		<			1,6	



Safe Operating Area with the transistor forward biased

I Region of permissible d.c. operation
II Permissible extension for repetitive pulse operation

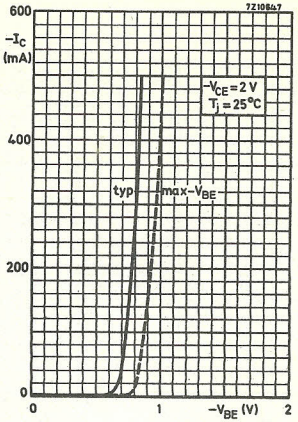
1) Independent of temperature

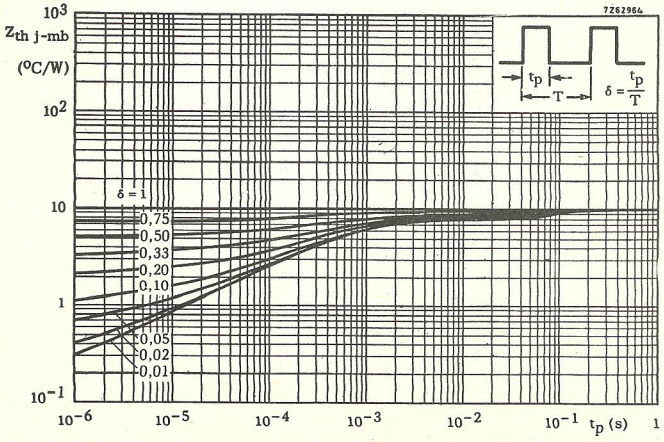


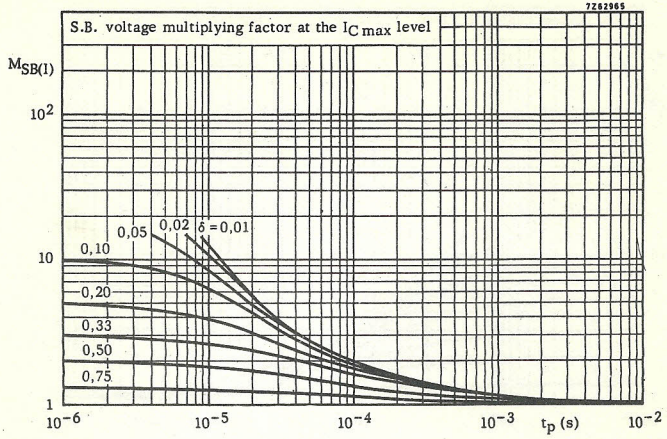
Safe Operating Area with the transistor forward biased

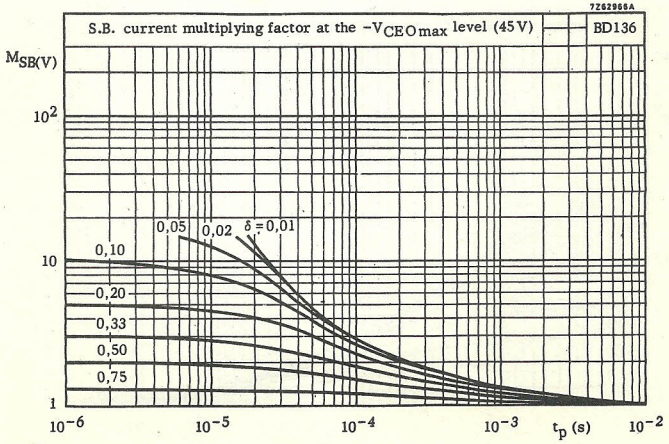
I Region of permissible d.c. operation
II Permissible extension for repetitive pulse operation
III Repetitive pulse operation in this region is allowable, provided $R_{BE} \leq 1$ kΩ.

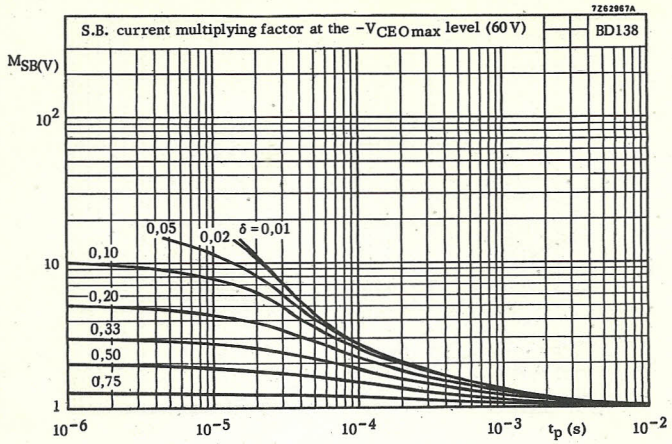
1) Independent of temperature

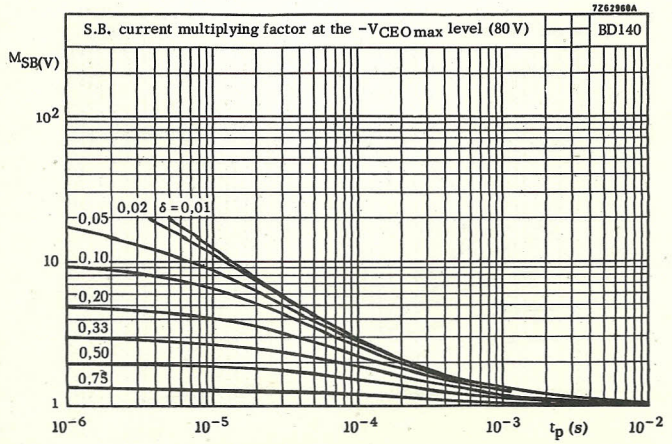

7Z10847
600
$-I_C$
(mA)
400
200
0
$-V_{CE}=2$ V
$T_j=25$°C
typ
max
$-V_{BE}$
0
1
$-V_{BE}$ (V)
2

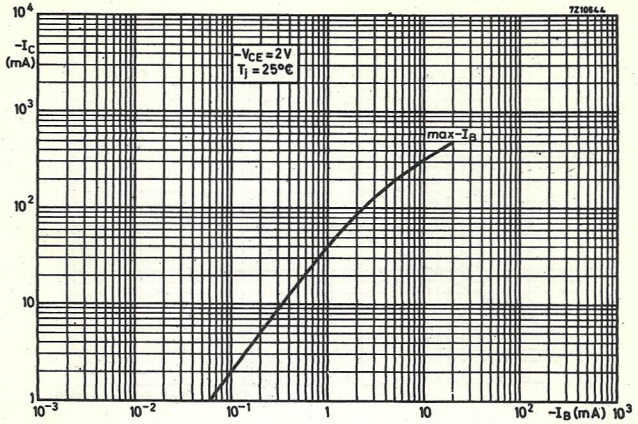

7Z62964
10^3
$Z_{th\ j\text{-}mb}$
(°C/W)
10^2
10
1
10^{-1}
$\delta = 1$
0,75
0,50
0,33
0,20
0,10
0,05
0,02
0,01
t_p
T
$\delta = \frac{t_p}{T}$
10^{-6}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
t_p (s)
1

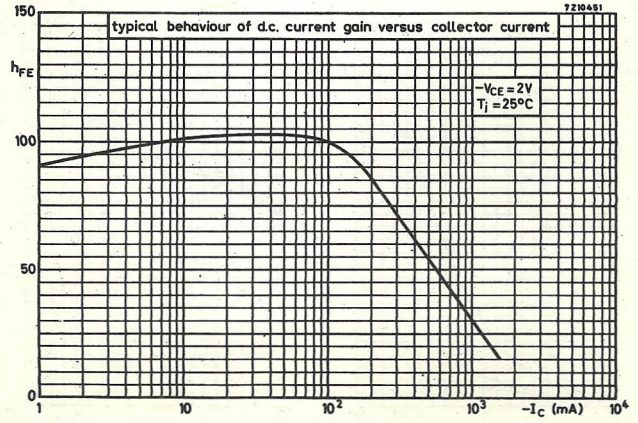

7Z62965
S.B. voltage multiplying factor at the $I_{C\,max}$ level
$M_{SB(I)}$
10^2
10
1
0,05
0,02
$\delta = 0,01$
0,10
0,20
0,33
0,50
0,75
10^{-6}
10^{-5}
10^{-4}
10^{-3}
t_p (s)
10^{-2}

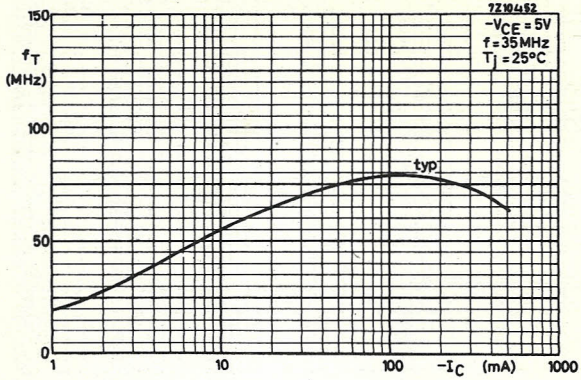

7Z62966A
S.B. current multiplying factor at the $-V_{CEO\,max}$ level (45 V)
BD136
$M_{SB(V)}$
10^2
10
1
0,05
0,02
$\delta = 0,01$
0,10
0,20
0,33
0,50
0,75
10^{-6}
10^{-5}
10^{-4}
10^{-3}
t_p (s)
10^{-2}

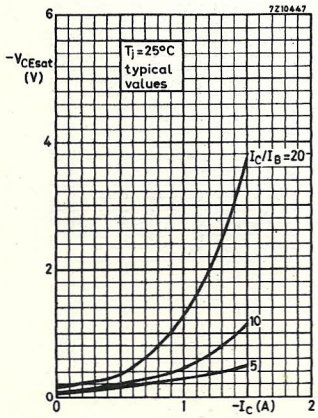

7Z62967A
S.B. current multiplying factor at the $-V_{CEO\,max}$ level (60 V)
BD138
$M_{SB(V)}$
10^2
10
1
0,05
0,02
δ = 0,01
0,10
0,20
0,33
0,50
0,75
10^{-6}
10^{-5}
10^{-4}
10^{-3}
t_p (s)
10^{-2}

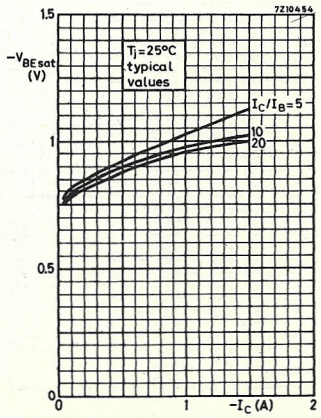

7Z62968A
S.B. current multiplying factor at the $-V_{CEO\,max}$ level (80 V)
BD140
$M_{SB(V)}$
10^2
10
1
0,05
0,02
δ = 0,01
0,10
0,20
0,33
0,50
0,75
10^{-6}
10^{-5}
10^{-4}
10^{-3}
t_p (s)
10^{-2}


7Z10644
10^4
$-I_C$
(mA)
$-V_{CE} = 2V$
$T_j = 25°C$
10^3
max-I_B
10^2
10
1
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
$-I_B$ (mA)
10^3


7Z10451
typical behaviour of d.c. current gain versus collector current
150
h_{FE}
$-V_{CE} = 2V$
$T_j = 25°C$
100
50
0
1
10
10^2
10^3
$-I_C$ (mA)
10^4







AUDIO FREQUENCY POWER TRANSISTORS

N-P-N silicon diffused power transistors in a TO-3 metal envelope for use in hi-fi audio equipment.
The BD181 is intended for 20 W into 4 Ω as well as 15 W into 8 Ω.
The BD182 is intended for 40 W into 4 Ω.
The BD183 is intended for 40 W into 8 Ω.
The transistors are also available as matched pairs under the typenumbers 2-BD181, 2-BD182 and 2-BD183.

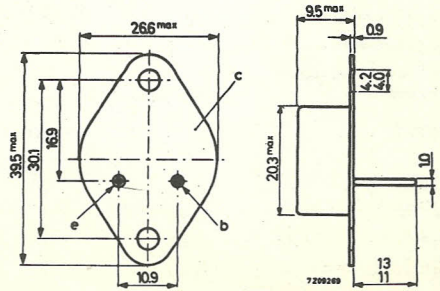
QUICK REFERENCE DATA

			BD181	BD182	BD183	
Collector-emitter voltage (open base)	V_{CEO}	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 100 Ω)	V_{CER}	max.	55	70	85	V
Collector current (peak value)	I_{CM}	max.	15	15	15	A
Total power dissipation						
up to T_{mb} = 25 °C	P_{tot}	max.	–	117	117	W
up to T_{mb} = 83 °C	P_{tot}	max.	78	–	–	W
Junction temperature	T_j	max.	200	200	200	°C
D.C. current gain						
I_C = 3 A; V_{CE} = 4 V	h_{FE}		20 to 70	–	20 to 70	
I_C = 4 A; V_{CE} = 4 V	h_{FE}		–	20 to 70	–	
Cut-off frequency						
I_C = 0.3 A; V_{CE} = 4 V	f_{hfe}	>	15	15	15	kHz

MECHANICAL DATA Dimensions in mm

Collector connected to envelope

TO-3



Accessories supplied on request: 56201e (for insulated mounting on a 2 mm heatsink)

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

			BD181	BD182	BD183	
Voltages						
Collector-base voltage (open emitter)	V_{CBO}	max.	55	70	85	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 100 Ω)	V_{CER}	max.	55	70	85	V
Emitter-base voltage (open collector)	V_{EBO}	max.	7	7	7	V
Currents						
Collector current (d.c.)	I_C	max.	10	15	15	A
Collector current (peak value)	I_{CM}	max.	15	15	15	A
Emitter current (peak value)	$-I_{EM}$	max.	15	15	15	A
Base current (peak value)	I_{BM}	max.	7	7	7	A
Power dissipation						
Total power dissipation up to T_{mb} = 25 °C	P_{tot}	max.	–	117	117	W
up to T_{mb} = 83 °C	P_{tot}	max.	78	–	–	W
Temperatures						
Storage temperature	T_{stg}		−65 to +200			°C
Junction temperature	T_j		max. 200			°C
THERMAL RESISTANCE						
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.5			°C/W
From junction to ambient	$R_{th\ j\text{-}a}$	=	45			°C/W
From mounting base to heatsink with accessory 56201e	$R_{th\ mb\text{-}h}$	=	0.75			°C/W

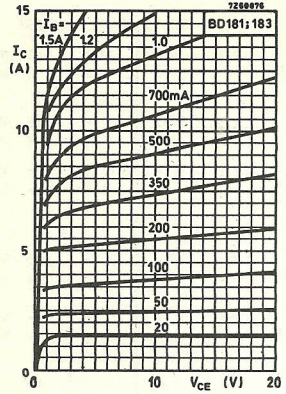
CHARACTERISTICS T_j = 25 °C unless otherwise specified

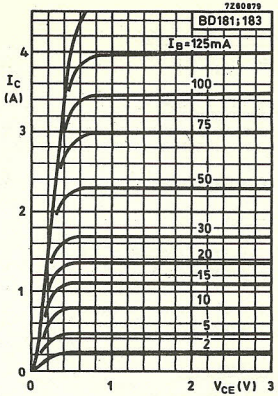
			BD181	BD182	BD183	
Collector cut-off current						
I_E = 0; V_{CB} = 45 V; T_j = 200 °C	I_{CBO}	<	2	–	–	mA
I_E = 0; V_{CB} = 60 V; T_j = 200 °C	I_{CBO}	<	–	5	–	mA
I_E = 0; V_{CB} = 80 V; T_j = 200 °C	I_{CBO}	<	–	–	5	mA

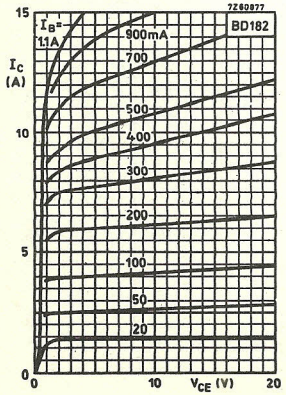
CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

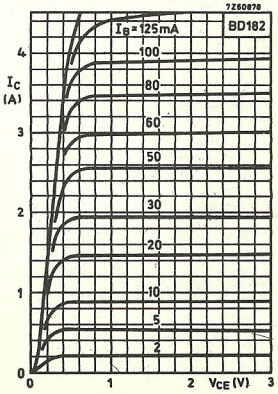
			BD181	BD182	BD183	
Emitter cut-off current						
I_C = 0; V_{EB} = 7 V	I_{EBO}	typ.	0.1	0.1	0.1	mA
		<	5	5	5	mA
Base-emitter voltage [1]						
I_C = 3 A; V_{CE} = 4 V	V_{BE}	typ.	1.15	–	1.15	V
		<	1.5	–	1.5	V
I_C = 4 A; V_{CE} = 4 V	V_{BE}	typ.	–	1.15	–	V
		<	–	1.5	–	V
Knee voltage						
I_C = 3 A; I_B = value for which I_C = 3.3 A at V_{CE} = 1.5 V	V_{CEK}	typ.	0.5	–	0.5	V
		<	1	–	1	V
I_C = 4 A; I_B = value for which I_C = 4.4 A at V_{CE} = 1.5 V	V_{CEK}	typ.	–	0.55	–	V
		<	–	1	–	V
D.C. current gain						
I_C = 3 A; V_{CE} = 4 V	h_{FE}	typ.	40	–	40	
			20 to 70	–	20 to 70	
I_C = 4 A; V_{CE} = 4 V	h_{FE}	typ.	–	40	–	
			–	20 to 70	–	
Linearity						
V_{CE} = 4 V						
h_{FE} at I_C = 0.3 A		typ.	2.5	–	2.5	
h_{FE} at I_C = 3 A		<	3.5	–	3.5	
h_{FE} at I_C = 0.3 A		typ.	–	2.5	–	
h_{FE} at I_C = 4 A		<	–	4.0	–	
Cut-off frequency						
I_C = 0.3 A; V_{CE} = 4 V	f_{hfe}	>	15	15	15	kHz
D.C. current gain ratio of matched pairs 2-BD181; 2-BD182 and 2-BD183						
I_C = 3 A; V_{CE} = 4 V	h_{FE1}/h_{FE2}	<	1.3	–	1.3	
I_C = 4 A; V_{CE} = 4 V	h_{FE1}/h_{FE2}	<	–	1.3	–	

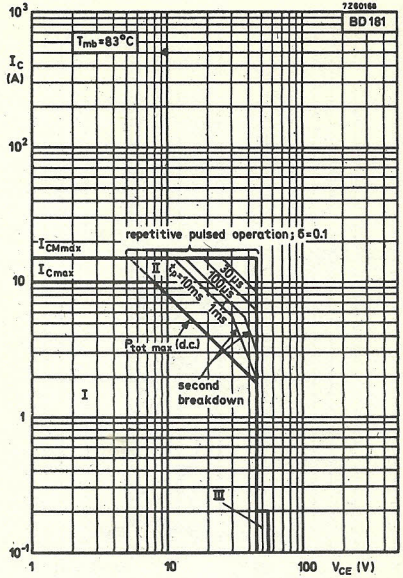
[1]) V_{BE} decreases by about 2 mV/°C with increasing temperature.









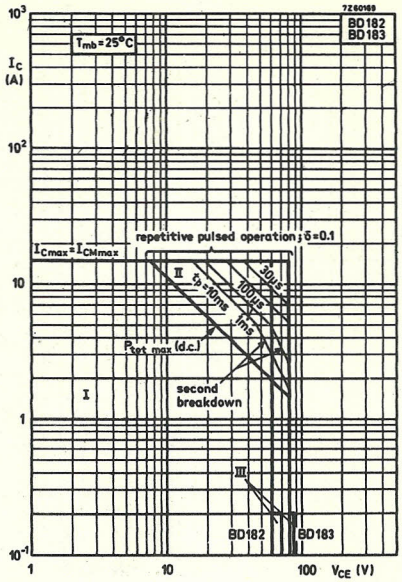


Safe Operating Area with the transistor forward biased

I Region of permissible d.c. operation

II Permissible extension for repetitive pulsed operation

III Repetitive pulsed operation in this region is allowable, provided $R_{BE} \leq 100\Omega$



Safe Operating Area with the transistor forward biased

I Region of permissible d.c. operation

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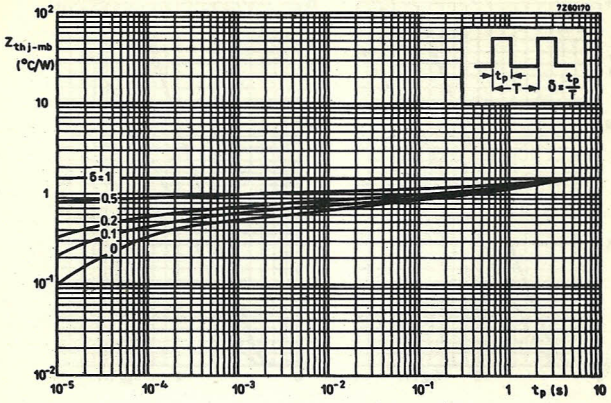
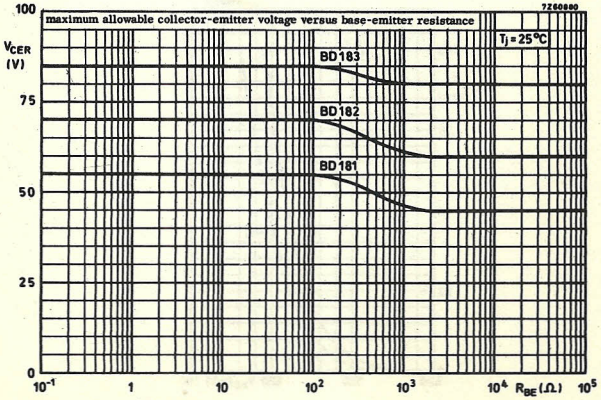
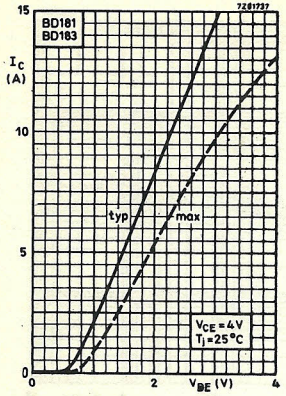
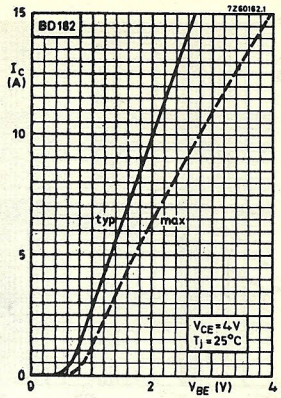
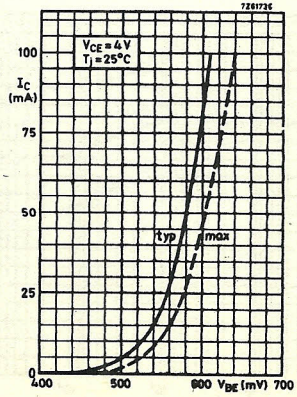
III Repetitive pulsed operation in this region is allowable, provided $R_{BE} \leq 100\Omega$

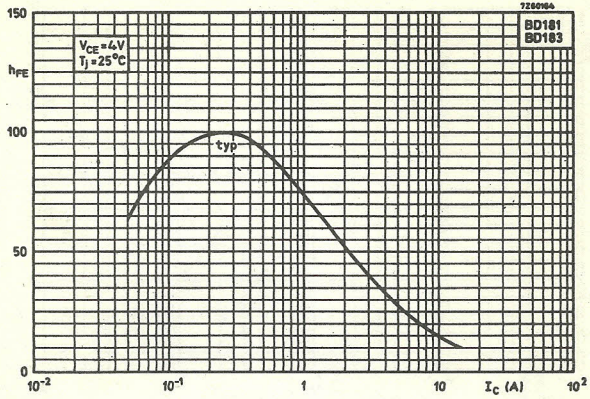


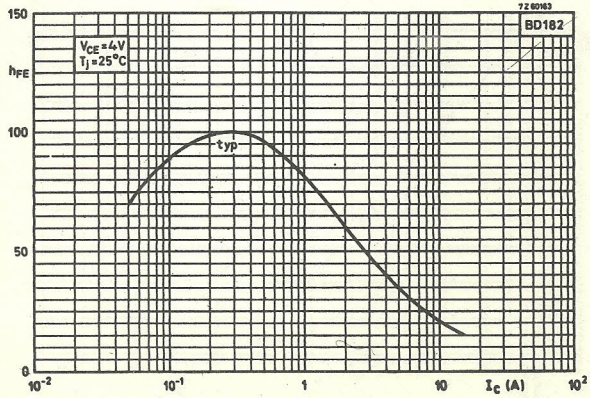


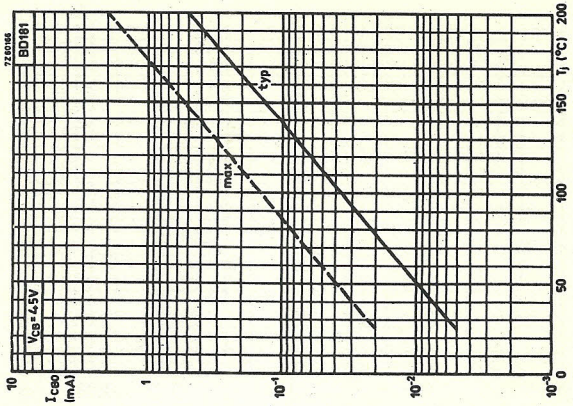

7Z81737
BD181
BD183
I_C (A)
15
10
5
0
typ
max
V_{CE} = 4V
T_j = 25°C
0
2
V_{BE} (V)
4

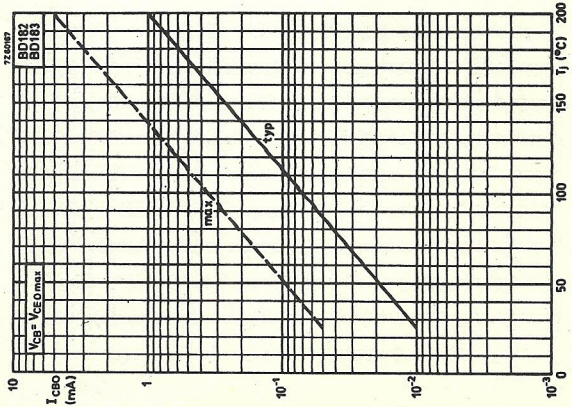

7Z60182.1
BD182
I_C (A)
15
10
5
0
typ
max
V_{CE} = 4V
T_j = 25°C
0
2
V_{BE} (V)
4


7Z81726
V_{CE} = 4V
T_j = 25°C
I_C (mA)
100
75
50
25
0
typ
max
400
500
600
V_{BE} (mV)
700


7Z60164
BD181
BD183
V_{CE} = 4V
T_j = 25°C
h_{FE}
150
100
50
0
typ
10^{-2}
10^{-1}
1
10
I_C (A)
10^2


7Z60163
BD182
V_{CE} = 4V
T_j = 25°C
h_{FE}
150
100
50
0
typ
10^{-2}
10^{-1}
1
10
I_C (A)
10^2





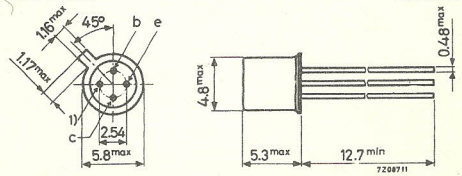
SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in TO-72 metal case with insulated electrodes and a shield lead connected to the case; the same transistor is available in lock-fit encapsulation under the type number BF194 or BF195. It is intended for general broadcast and television.

QUICK REFERENCE DATA				
Collector-base voltage (open emitter)	V_{CBO}	max.	50	V
Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Collector current (d.c.)	I_C	max.	30	mA
Total power dissipation up to T_{amb} = 45 °C	P_{tot}	max.	145	mW
Junction temperature	T_j	max.	175	°C
Transition frequency				
I_C = 1 mA; V_{CE} = 10 V	f_T	typ.	230	MHz
Noise figure				
I_C = 1 mA; V_{CE} = 10 V				
f = 1 MHz; G_S = 3.3 mΩ^{-1}	F	typ.	1.2	dB
f = 100 MHz; G_S = 10 mΩ^{-1}	F	typ.	4	dB

MECHANICAL DATA Dimensions in mm

TO-72



1) = shield lead (connected to case)

Accessories available: 56246, 56263.

FOR NEW DESIGN THE SUCCESSOR TYPES BF494 OR BF495 ARE RECOMMENDED

RATINGS (Limiting values) [1])

Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	50	V
Collector-emitter voltage (open base) (See also page 5)	V_{CEO}	max.	30	V
Collector-emitter voltage (see page 5)	V_{CER}	max.	50	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	V

Currents

Collector current (d.c.)	I_C	max.	30	mA
Collector current (peak value)	I_{CM}	max.	30	mA

Power dissipation

Total power dissipation up to T_{amb} = 45 °C	P_{tot}	max.	145	mW

Temperatures

Storage temperature	T_{stg}		−65 to +175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.9	°C/mW

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

SILICON PLANAR TRANSISTOR

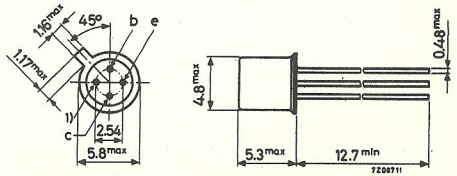
N-P-N transistor in a TO-72 metal envelope with a shield lead connected to the case; the same transistor is available in lock-fit encapsulation under the type-number BF196. It has a very low feedback capacitance and is intended for use in forward gain control stages in video intermediate frequency amplifiers of television receivers.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	40	V
Collector-emitter voltage (open base)	V_{CEO}	max.	30	V
Collector current (d.c.)	I_C	max.	25	mA
Total power dissipation up to T_{amb} = 45 °C	P_{tot}	max.	130	mW
Junction temperature	T_j	max.	175	°C
Transition frequency I_C = 4 mA; V_{CE} = 10 V	f_T	typ.	350	MHz
Feedback capacitance at f = 10.7 MHz I_C = 1 mA; V_{CE} = 10 V	$-C_{re}$	typ.	0.15	pF
Max. unilateralised power gain I_C = 4 mA; V_{CE} = 10 V; f = 35 MHz	G_{UM}	typ.	42	dB
Gain control range	ΔG_{tr}	typ.	60	dB

MECHANICAL DATA Dimensions in mm

TO-72



1) = shield lead (connected to case)

Accessories available: 56246, 56263

RATINGS (Limiting values) [1])

Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	40	V
Collector-emitter voltage (open base) (See also page 5)	V_{CEO}	max.	30	V
Emitter-base voltage (open collector)	V_{EBO}	max.	4	V

Currents

Collector current (d.c.)	I_C	max.	25	mA
Collector current (peak value)	I_{CM}	max.	25	mA

Power dissipation

Total power dissipation up to T_{amb} = 45 °C	P_{tot}	max.	130	mW

Temperatures

Storage temperature	T_{stg}		−65 to +175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$		1.0	°C/mW

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

CHARACTERISTICS T_{amb} = 25 °C unless otherwise specified

Base current

I_C = 4 mA; V_{CE} = 10 V	I_B	typ.	70	μA
		<	150	μA

Base-emitter voltage

I_C = 4 mA; V_{CE} = 10 V	V_{BE}	typ.	700	mV [1])

Feedback capacitance at f = 10.7 MHz

I_C = 1 mA; V_{CE} = 10 V	$-C_{re}$	typ.	150	fF [2])

Transition frequency

I_C = 4 mA; V_{CE} = 10 V	f_T	typ.	350	MHz

Noise figure at f = 35 MHz

I_C = 4 mA; V_{CE} = 10 V; G_S = 10 mΩ^{-1}; B_S = 0	F	typ.	3	dB

y parameters at f = 35 MHz

I_C = 4 mA; V_{CE} = 10 V

Input conductance	g_{ie}	typ.	4.8	mΩ^{-1}
Input capacitance	C_{ie}	typ.	45	pF
Feedback admittance	$\|y_{re}\|$	typ.	37	μΩ^{-1}
Phase angle of feedback admittance	φ_{re}	typ.	268°	
Transfer admittance	$\|y_{fe}\|$	typ.	95	mΩ^{-1}
Phase angle of transfer admittance	φ_{fe}	typ.	337°	
Output conductance	g_{oe}	typ.	30	μΩ^{-1}
Output capacitance	C_{oe}	typ.	1.2	pF

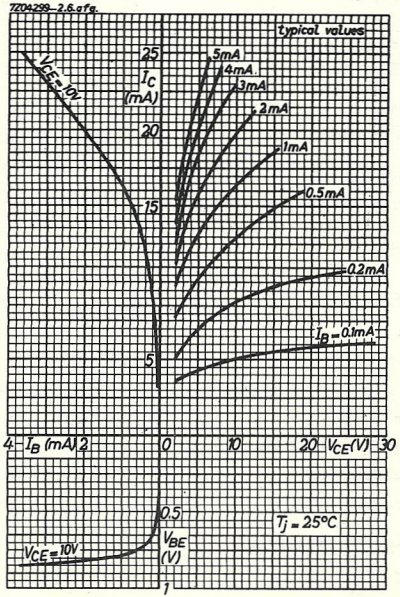
Maximum unilateralised power gain

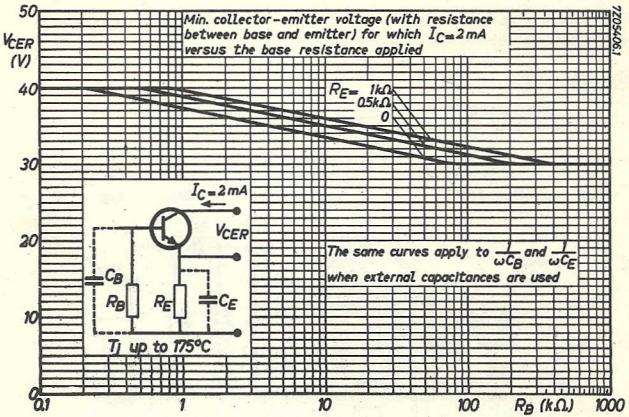
$$G_{UM} = \frac{|y_{fe}|^2}{4\, g_{ie}\, g_{oe}}$$

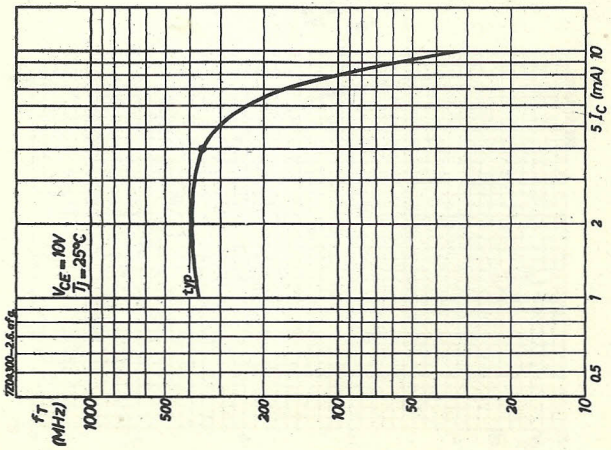
I_C = 4 mA; V_{CE} = 10 V; f = 35 MHz	G_{UM}	typ.	42	dB

[1]) V_{BE} decreases with about 1.7 mV/°C at increasing temperature

[2]) 1 fF = 1 femtofarad = 10^{-15} F


7Z04299-2.6.afg.
typical values
I_C (mA)
25
20
15
5
V_{CE}=10V
5mA
4mA
3mA
2mA
1mA
0.5mA
0.2mA
I_B=0.1mA
4 I_B (mA) 2
0
10
20 V_{CE}(V) 30
0.5
V_{BE} (V)
1
V_{CE}=10V
T_j = 25°C


7Z05406.1
Min. collector-emitter voltage (with resistance between base and emitter) for which I_C=2mA versus the base resistance applied
V_{CER} (V)
50
40
30
20
10
0
R_E= 1kΩ
0.5kΩ
0
I_C=2mA
V_{CER}
C_B
R_B
R_E
C_E
T_j up to 175°C
The same curves apply to $\frac{1}{\omega C_B}$ and $\frac{1}{\omega C_E}$ when external capacitances are used
0.1
1
10
100
R_B (kΩ)
1000


7Z04300-2.6.afg.
V_{CE}=10V
T_j=25°C
typ
f_T (MHz)
1000
500
200
100
50
20
10
I_C (mA)
10
5
2
1
0.5

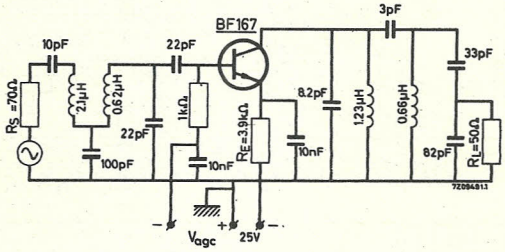
APPLICATION INFORMATION

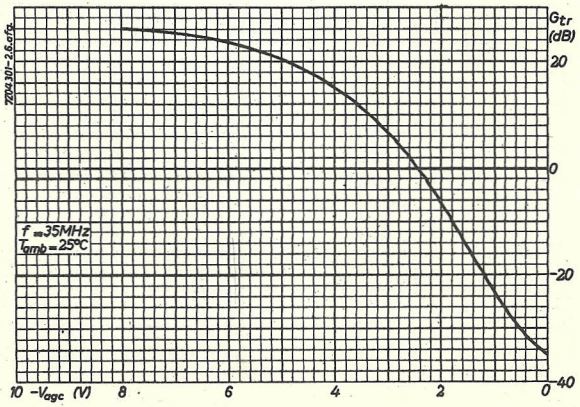
First stage of an intermediate frequency amplifier with a BF167 transistor. (Basic circuit with voltage gain control).

Transducer gain

$$G_{tr} = \frac{\text{output power in load } R_L}{\text{available power from source with } R_S}$$

I_C = 4 mA; f = 35 MHz	G_{tr}	typ.	26	dB
Gain control range	ΔG_{tr}	typ.	60	dB





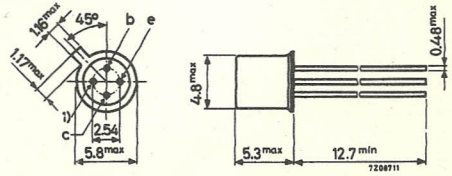
SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a TO-72 metal envelope with a shield lead connected to the case; the same transistor is available in lock-fit encapsulation under the type-number BF197. It has a very low feedback capacitance and is intended for use in video intermediate frequency amplifiers, in particular for the output stages.

QUICK REFERENCE DATA				
Collector-base voltage (open emitter)	V_{CBO}	max.	40	V
Collector-emitter voltage (open base)	V_{CEO}	max.	25	V
Collector current (d.c.)	I_C	max.	25	mA
Total power dissipation up to T_{amb} = 45 °C	P_{tot}	max.	260	mW
Junction temperature	T_j	max.	175	°C
Transition frequency				
I_C = 5 mA; V_{CE} = 10 V	f_T	typ.	550	MHz
Feedback capacitance at f = 10.7 MHz				
I_C = 1 mA; V_{CE} = 10 V	$-C_{re}$	typ.	0.23	pF
Max. unilateralised power gain				
I_C = 7 mA; V_{CE} = 10 V; f = 35 MHz	G_{UM}	typ.	42.5	dB
Output voltage in the circuit of page 4	V_O	typ.	7.7	V

MECHANICAL DATA Dimensions in mm

TO-72



1) = shield lead (connected to case)

Accessories available: 56246, 56263

RATINGS (Limiting values) [1]

Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	40	V
Collector-emitter voltage (open base) (See also page A)	V_{CEO}	max.	25	V
Emitter-base voltage (open collector)	V_{EBO}	max.	4	V

Currents

Collector current (d.c.)	I_C	max.	25	mA
Collector current (peak value)	I_{CM}	max.	25	mA

Power dissipation

Total power dissipation up to T_{amb} = 45 °C with cooling fin No. 56263 [2]	P_{tot}	max.	260	mW

Temperatures

Storage temperature	T_{stg}		−65 to +175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\,j\text{-}a}$	=	0.65	°C/mW
From junction to ambient with cooling fin No. 56263	$R_{th\,j\text{-}a}$	=	0.5	°C/mW

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

[2]) Peak power dissipation see page 5.

CHARACTERISTICS T_{amb} = 25 °C unless otherwise specified

Base current

I_C = 7 mA; V_{CE} = 10 V	I_B	typ.	80	μA
		<	185	μA

Base-emitter voltage

I_C = 7 mA; V_{CE} = 10 V	V_{BE}	typ.	740	mV [1])
		<	900	mV

Feedback capacitance at f = 10.7 MHz

I_C = 1 mA; V_{CE} = 10 V	$-C_{re}$	typ.	230	fF [2])

Transition frequency

I_C = 5 mA; V_{CE} = 10 V	f_T	typ.	550	MHz

y parameters at f = 35 MHz

I_C = 7 mA; V_{CE} = 10 V

Input conductance	g_{ie}	typ.	4.5	$m\Omega^{-1}$
Input capacitance	C_{ie}	typ.	45	pF
Feedback admittance	$\lvert y_{re}\rvert$	typ.	55	$\mu\Omega^{-1}$
Phase angle of feedback admittance	φ_{re}	typ.	266°	
Transfer admittance	$\lvert y_{fe}\rvert$	typ.	145	$m\Omega^{-1}$
Phase angle of transfer admittance	φ_{fe}	typ.	338°	
Output conductance	g_{oe}	typ.	65	$\mu\Omega^{-1}$
Output capacitance	C_{oe}	typ.	2.1	pF

Maximum unilateralised power gain

$$G_{UM} = \frac{|y_{fe}|^2}{4\, g_{ie}\, g_{oe}}$$

I_C = 7 mA; V_{CE} = 10 V; f = 35 MHz	G_{UM}	typ.	42.5	dB

[1]) V_{BE} decreases with about 1.7 mV/°C at increasing temperature

[2]) 1 fF = 1 femtofarad = 10^{-15} F

APPLICATION INFORMATION

Output stage of an intermediate frequency amplifier with a BF173 transistor.

Output voltage of the i.f. output stage

Voltage across the detector load R_L = 2.7 kΩ
for 30% synchronisation pulse compression

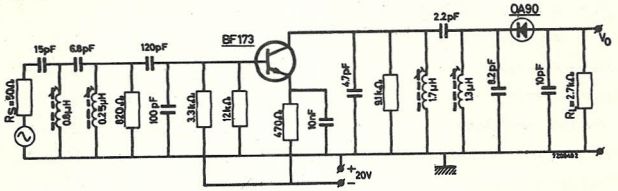
f = 38.9 MHz; I_C = 7.2 mA; V_{CE} = 16.6 V — V_O > 6 V; typ. 7.7 V

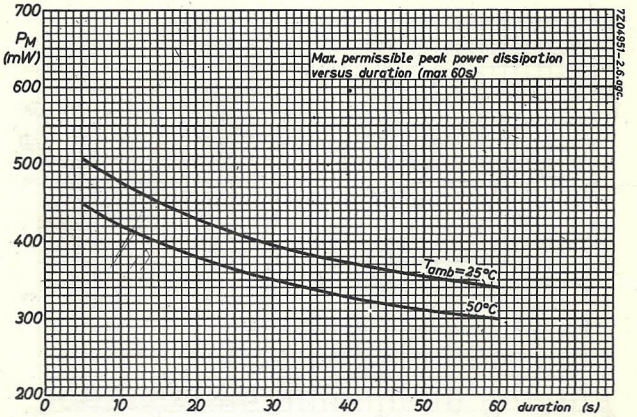
Transducer gain

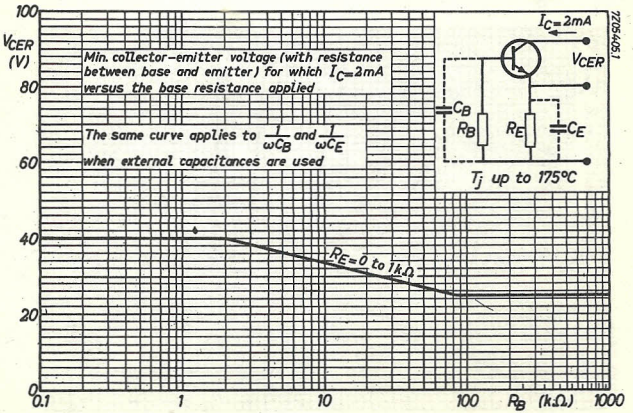
$$G_{tr} = \frac{\text{output power in load } R_L}{\text{available power from source with } R_S}$$

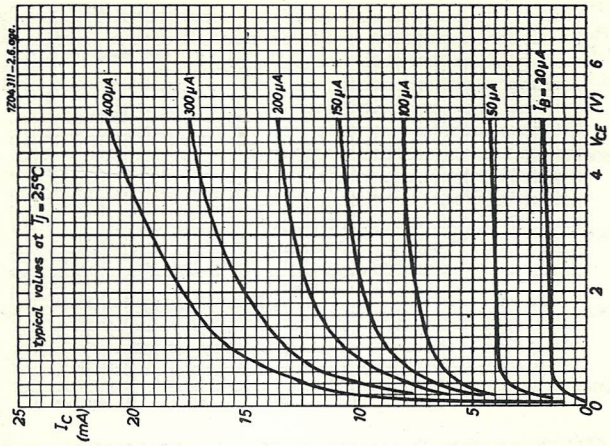
f = 36.4 MHz; I_C = 7.2 mA; V_{CE} = 16.6 V — G_{tr} typ. 26 dB

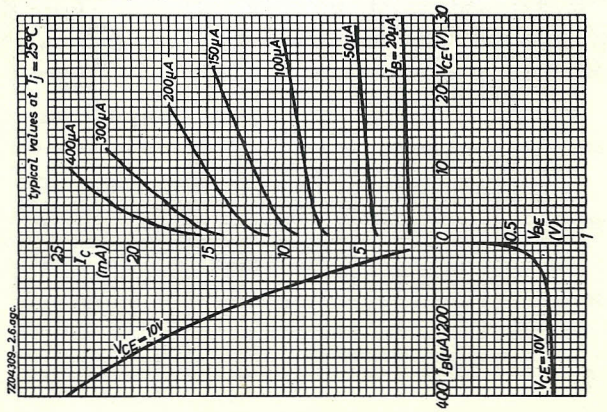
Tuning frequency for all tuned circuits is 37 MHz











SILICON PLANAR EPITAXIAL TRANSISTOR

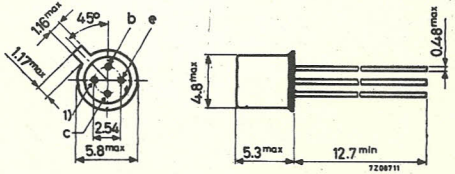
N-P-N transistor in a TO-72 metal case with insulated electrodes and a shield lead connected to the case; the same transistor is available in lock-fit encapsulation under the type number BF194.

The BF184 is intended for h.f. applications in radio and television receivers; it is especially recommended for f.m. tuners, low noise a.m. mixer-oscillators with high source impedance and i.f. amplifiers in a.m./f.m. receivers where a high current gain is of importance.

QUICK REFERENCE DATA				
Collector-base voltage (open emitter)	V_{CBO}	max.	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	20	V
Collector current (d.c.)	I_C	max.	30	mA
Total power dissipation up to T_{amb} = 45 °C	P_{tot}	max.	145	mW
Junction temperature	T_j	max.	175	°C
D.C. current gain at T_j = 25 °C				
I_C = 1 mA; V_{CE} = 10 V	h_{FE}	typ.	115	
Transition frequency				
I_C = 1 mA; V_{CE} = 10 V	f_T	typ.	300	MHz

MECHANICAL DATA Dimensions in mm

TO-72
Insulated electrodes



1) = shield lead (connected to case)

Accessories available: 56246, 56263.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	30	V
Collector-emitter voltage (open base) (See also sheet 4)	V_{CEO}	max.	20	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	V

Currents

Collector current (d.c.)	I_C	max.	30	mA
Collector current (peak value)	I_{CM}	max.	30	mA

Power dissipation

Total power dissipation up to T_{amb} = 45 °C	P_{tot}	max.	145	mW

Temperatures

Storage temperature	T_{stg}		−65 to +175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.9	°C/mW

For further information see BF494

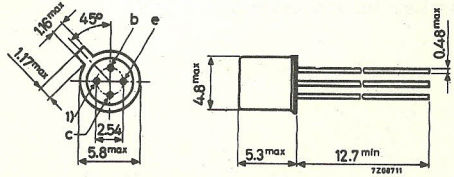
SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a TO-72 metal case with insulated electrodes and a shield lead connected to the case; the same transistor is available in lock-fit encapsulation under the type number BF195.
The BF185 is intended for h.f. applications in radio and television receivers; it is especially recommended for f.m. tuners, i.f. amplifiers in a.m./f.m. receivers where a low transistor output conductance is of importance, a.m. input stages of carradios where a low noise figure at low source impedance is required.

QUICK REFERENCE DATA				
Collector-base voltage (open emitter)	V_{CBO}	max.	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	20	V
Collector current (d.c.)	I_C	max.	30	mA
Total power dissipation up to T_{amb} = 45 °C	P_{tot}	max.	145	mW
Junction temperature	T_j	max.	175	°C
D.C. current gain at T_j = 25 °C				
I_C = 1 mA; V_{CE} = 10 V	h_{FE}	typ.	67	
Transition frequency				
I_C = 1 mA; V_{CE} = 10 V	f_T	typ.	220	MHz
Noise figure at f = 100 MHz				
I_C = 1 mA: V_{CE} = 10 V; G_S = 10 mA/V	F	typ.	4	dB

MECHANICAL DATA — Dimensions in mm

TO-72



1) = shield lead (connected to case)

Accessories available: 56246, 56263.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	30	V
Collector-emitter voltage (open base) (See also sheet 8)	V_{CEO}	max.	20	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	V

Currents

Collector current (d.c.)	I_C	max.	30	mA
Collector current (peak value)	I_{CM}	max.	30	mA

Power dissipation

Total power dissipation up to T_{amb} = 45 °C	P_{tot}	max.	145	mW

Temperatures

Storage temperature	T_{stg}		−65 to +175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.9	°C/mW

For further information see BF495

N-CHANNEL SILICON FIELD-EFFECT TRANSISTORS

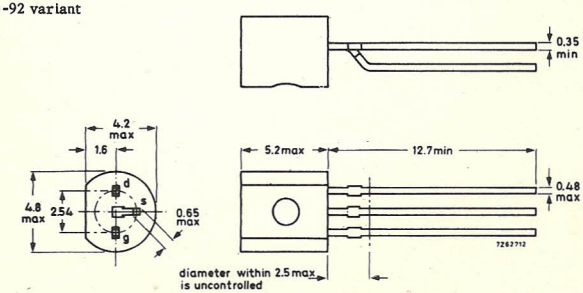
General purpose symmetrical N-channel planar epitaxial junction field-effect transistors in a plastic TO-92 variant; intended for applications in l.f. and d.c. amplifiers, and in h.f. amplifiers.

QUICK REFERENCE DATA

Drain-source voltage	$\pm V_{DS}$		max.		30	V
Gate-source voltage (open drain)	$-V_{GSO}$		max.		30	V
Total power dissipation up to T_{amb} = 75 °C	P_{tot}		max.		300	mW
			BF245A	B	C	
Drain current V_{DS} = 15 V; V_{GS} = 0	I_{DSS}	>	2	6,0	12	mA
		<	6,5	15,0	25	mA
Gate-source cut-off voltage I_D = 10 nA; V_{DS} = 15 V	$-V_{(P)GS}$			0,5 to 8,0		V
Feedback capacitance at f = 1 kHz V_{DS} = 20 V; $-V_{GS}$ = 1 V; T_{amb} = 25 °C	C_{rs}		typ.		1,1	pF
Transfer admittance (common source) V_{DS} = 15 V; V_{GS} = 0; f = 1 kHz; T_{amb} = 25 °C	$\|y_{fs}\|$			3,0 to 6,5		mA/V

MECHANICAL DATA Dimensions in mm

TO-92 variant



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages

Drain-source voltage	$\pm V_{DS}$	max.	30	V	
Drain-gate voltage (open source)	V_{DGO}	max.	30	V	
Gate-source voltage (open drain)	$-V_{GSO}$	max.	30	V	

Currents

Drain current	I_D	max.	25	mA	
Gate current	I_G	max.	10	mA	

Power dissipation

Power dissipation up to T_{amb} = 75 °C	P_{tot}	max.	300	mW	
up to T_{amb} = 90 °C	P_{tot}	max.	300	mW	1)

Temperatures

Storage temperature	T_{stg}	−65 to +150	°C	
Junction temperature	T_j	max. 150	°C	

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0,25	°C/mW	
From junction to ambient	$R_{th\ j\text{-}a}$	=	0,20	°C/mW	1)

1) Transistor mounted on printed circuit board, max. lead length 3 mm, mounting pad for drain lead minimum 10 mm x 10 mm.

CHARACTERISTICS T_j = 25 °C unless otherwise specified

		BF245A	B	C	
Gate cut-off current					
$-V_{GS}$ = 20 V; V_{DS} = 0	$-I_{GSS}$	< 5	5	5	nA
$-V_{GS}$ = 20 V; V_{DS} = 0; T_j = 125 °C	$-I_{GSS}$	< 0,5	0,5	0,5	μA
Drain current 1)					
V_{DS} = 15 V; V_{GS} = 0	I_{DSS}	> 2	6,0	12	mA
		< 6,5	15,0	25	mA
Gate-source breakdown voltage					
$-I_G$ = 1 μA; V_{DS} = 0	$-V_{(BR)GSS}$	> 30	30	30	V
Gate-source voltage					
I_D = 200 μA; V_{DS} = 15 V	$-V_{GS}$	> 0,4	1,6	3,2	V
		< 2,2	3,8	7,5	V
Gate-source cut-off voltage					
I_D = 10 nA; V_{DS} = 15 V	$-V_{(P)GS}$	0,5 to 8,0			V

y-parameters at T_{amb} = 25 °C (common source)

V_{DS} = 15 V; V_{GS} = 0					
f = 1 kHz	Transfer admittance	$\|y_{fs}\|$	3,0 to 6,5		mA/V
	Output admittance	$\|y_{os}\|$	typ.	25	μA/V
f = 200 MHz	Input conductance	g_{is}	typ.	250	μA/V
	Reverse transfer admittance	$\|y_{rs}\|$	typ.	1,4	mA/V
	Transfer admittance	$\|y_{fs}\|$	typ.	6	mA/V
	Output conductance	g_{os}	typ.	40	μA/V
V_{DS} = 20 V; $-V_{GS}$ = 1 V					
f = 1 MHz	Input capacitance	C_{is}	typ.	4,0	pF
	Feedback capacitance	C_{rs}	typ.	1,1	pF
	Output capacitance	C_{os}	typ.	1,6	pF

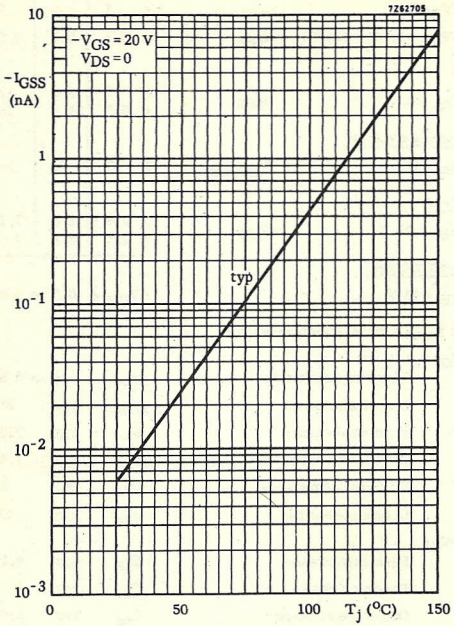
Cut-off frequency 2)

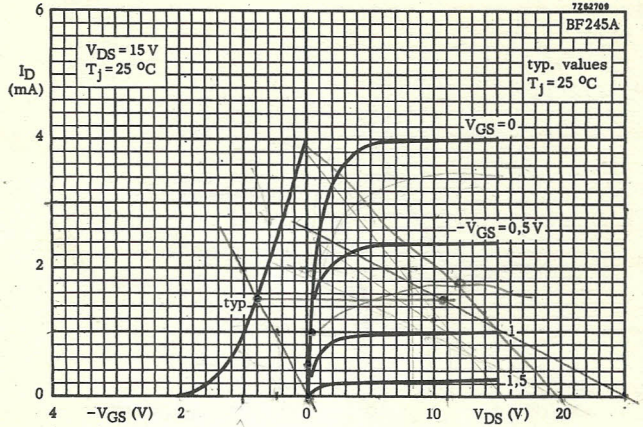
V_{DS} = 15 V; V_{GS} = 0	f_{gfs}	typ.	700	MHz

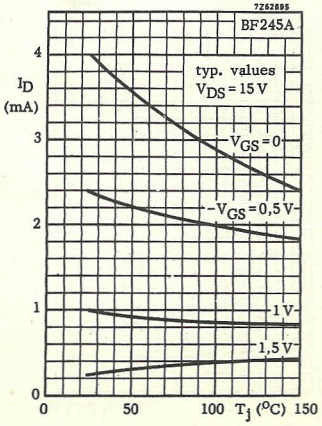
Noise figure at f = 100 MHz; R_G = 1 kΩ (common source)

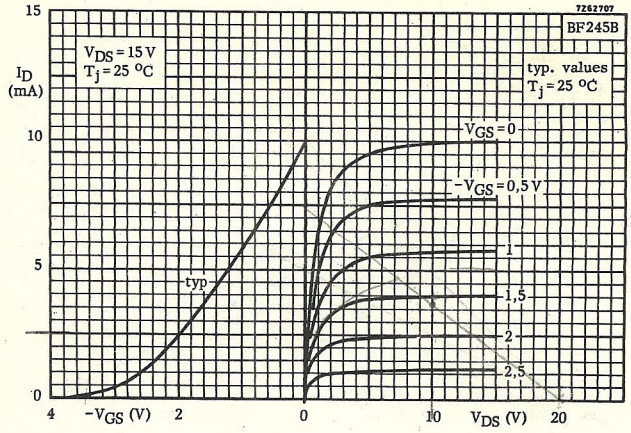
V_{DS} = 15 V; V_{GS} = 0; T_{amb} = 25 °C input tuned to minimum noise	F	typ.	1,5	dB

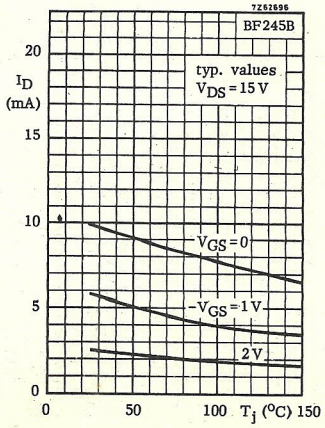
1) Measured under pulse condition: t_p = 300 μs; δ ≤ 0,02
2) The frequency at which g_{fs} is 0,7 of its value at 1 kHz.


7Z62705
$-V_{GS} = 20$ V
$V_{DS} = 0$
$-I_{GSS}$ (nA)
10
1
10^{-1}
10^{-2}
10^{-3}
typ
0
50
100
T_j (°C)
150

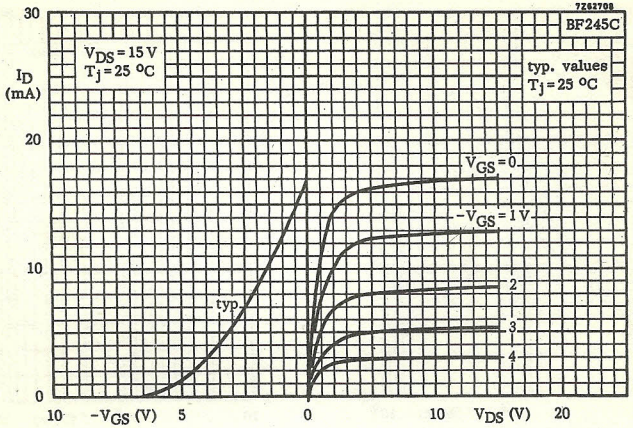

7Z62709
BF245A
$V_{DS} = 15$ V
$T_j = 25$ °C
typ. values
$T_j = 25$ °C
I_D (mA)
6
4
2
0
$V_{GS} = 0$
$-V_{GS} = 0,5$ V
1
1,5
typ
4
$-V_{GS}$ (V)
2
0
10
V_{DS} (V)
20

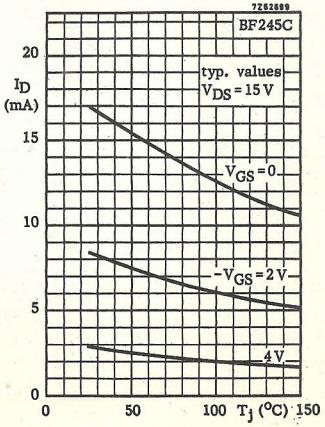

7Z62695
BF245A
typ. values
$V_{DS} = 15$ V
I_D (mA)
4
3
2
1
0
$V_{GS} = 0$
$-V_{GS} = 0,5$ V
1 V
1,5 V
0
50
100
T_j (°C)
150

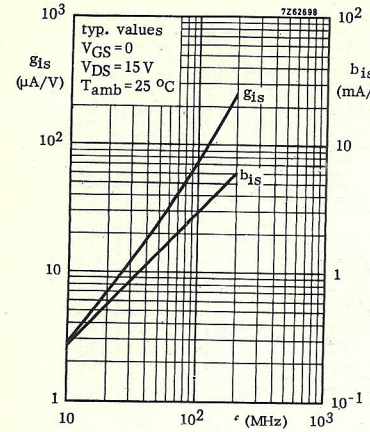

7Z62707
BF245B
V_{DS} = 15 V
T_j = 25 °C
typ. values
T_j = 25 °C
I_D (mA)
V_{GS} = 0
$-V_{GS}$ = 0,5 V
1
1,5
2
2,5
typ
$-V_{GS}$ (V)
V_{DS} (V)

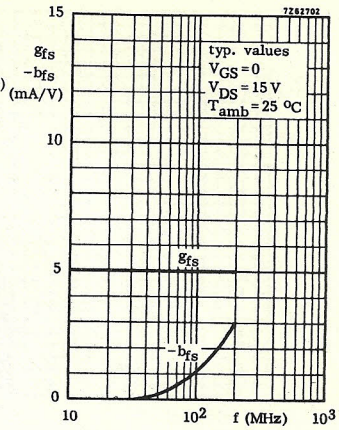

7Z62696
BF245B
typ. values
V_{DS} = 15 V
I_D (mA)
V_{GS} = 0
$-V_{GS}$ = 1 V
2 V
T_j (°C)

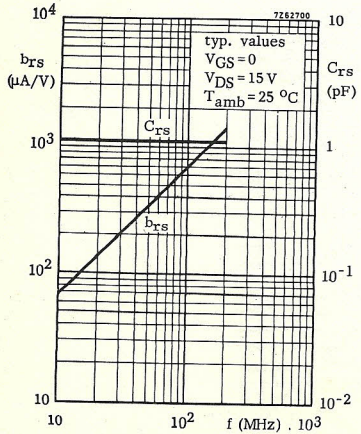
3,3 K
8k20

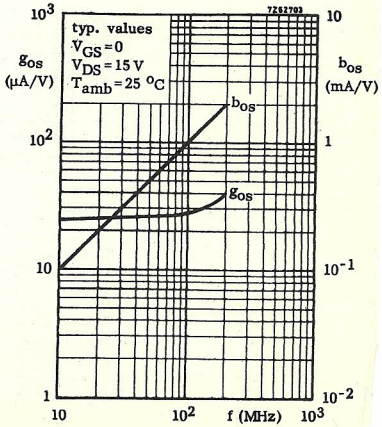

7Z62708
BF245C
V_{DS} = 15 V
T_j = 25 °C
typ. values
T_j = 25 °C
I_D (mA)
V_{GS} = 0
$-V_{GS}$ = 1 V
2
3
4
typ
$-V_{GS}$ (V)
V_{DS} (V)

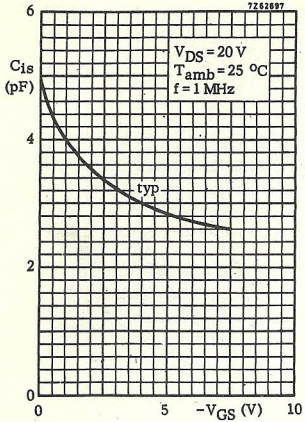

7Z62699
BF245C
typ. values
V_{DS} = 15 V
I_D (mA)
V_{GS} = 0
$-V_{GS}$ = 2 V
4 V
T_j (°C)

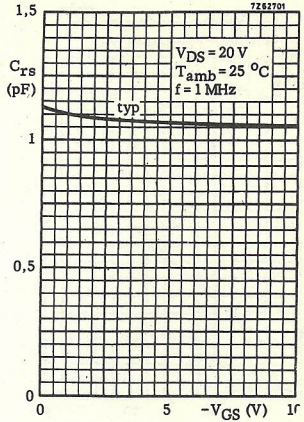

7Z62698
typ. values
V_{GS} = 0
V_{DS} = 15 V
T_{amb} = 25 °C
g_{is} (μA/V)
b_{is} (mA/V)
g_{is}
b_{is}
f (MHz)

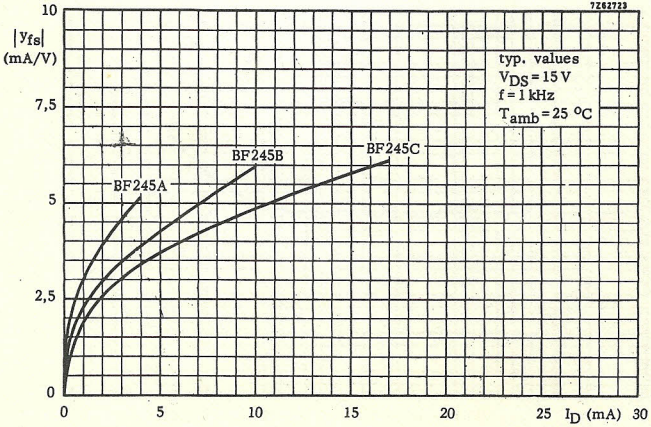

7Z62702
typ. values
V_{GS} = 0
V_{DS} = 15 V
T_{amb} = 25 °C
g_{fs}
$-b_{fs}$ (mA/V)
g_{fs}
$-b_{fs}$
f (MHz)

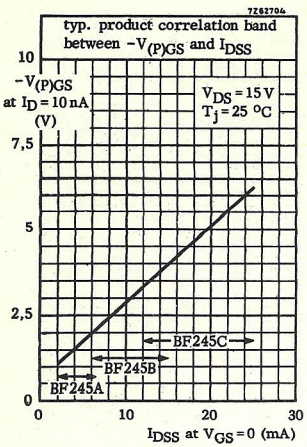

7Z62700
typ. values
V_{GS} = 0
V_{DS} = 15 V
T_{amb} = 25 °C
b_{rs} (μA/V)
C_{rs} (pF)
C_{rs}
b_{rs}
f (MHz)

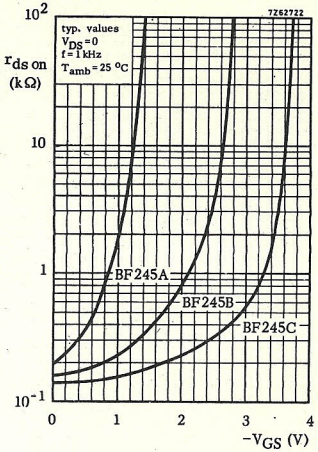

7Z62703
typ. values
V_{GS} = 0
V_{DS} = 15 V
T_{amb} = 25 °C
g_{os} (μA/V)
b_{os} (mA/V)
b_{os}
g_{os}
f (MHz)

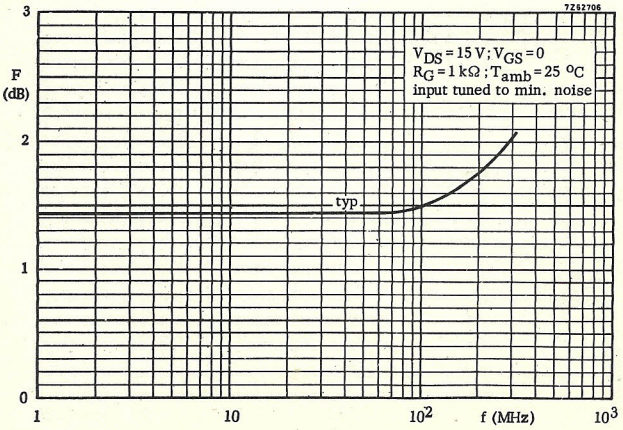

7Z62697
V_{DS} = 20 V
T_{amb} = 25 °C
f = 1 MHz
C_{is} (pF)
typ
$-V_{GS}$ (V)


7Z62701
V_{DS} = 20 V
T_{amb} = 25 °C
f = 1 MHz
C_{rs} (pF)
typ
$-V_{GS}$ (V)


7Z62723
typ. values
V_{DS} = 15 V
f = 1 kHz
T_{amb} = 25 °C
$|y_{fs}|$ (mA/V)
BF245A
BF245B
BF245C
I_D (mA)





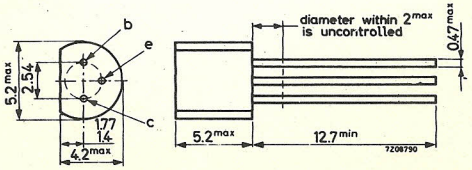


SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a plastic envelope.
The BF254 is intended for h.f. applications in radio and television receivers; it is especially recommended for f.m. tuners, low noise a.m. mixer-oscillators with high source impedance and i.f. amplifiers in a.m./f.m. receivers where a high current gain is of importance.

QUICK REFERENCE DATA				
Collector-base voltage (open emitter)	V_{CBO}	max.	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	20	V
Collector current (d.c.)	I_C	max.	30	mA
Total power dissipation up to $T_{amb} = 25$ °C	P_{tot}	max.	300	mW
Junction temperature	T_j	max.	125	°C
D.C. current gain at $T_j = 25$ °C $I_C = 1$ mA; $V_{CE} = 10$ V	h_{FE}	typ.	115	
Transition frequency at f = 35 MHz $I_C = 1$ mA; $V_{CE} = 10$ V	f_T	typ.	260	MHz
Noise figure at f = 100 MHz $I_C = 1$ mA; $V_{CE} = 10$ V; $G_S = 10$ mΩ^{-1}	F	typ.	4	dB
Conversion noise figure at f = 1 MHz $I_C = 1$ mA; $V_{CE} = 10$ V; $G_S = 1.2$ mΩ^{-1}	F_c	typ.	2	dB

MECHANICAL DATA Dimensions in mm



FOR NEW DESIGN THE SUCCESSOR TYPE BF494 IS RECOMMENDED

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	30	V
Collector-emitter voltage (open base) (See also page 4)	V_{CEO}	max.	20	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	V

Currents

Collector current (d.c.)	I_C	max.	30	mA
Collector current (peak value)	I_{CM}	max.	30	mA

Power dissipation

Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW

Temperatures

Storage temperature	T_{stg}		−65 to +125	°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.33	°C/mW

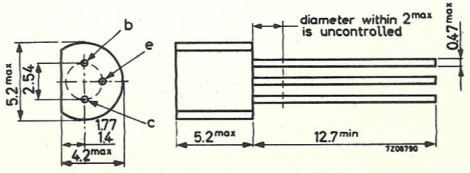
SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a plastic envelope.
The BF255 is intended for h.f. applications in radio and television receivers; it is especially recommended for f.m. tuners, i.f. amplifiers in a.m./f.m. receivers where a low transistor output conductance is of importance, a.m. input stages of carradios where a low noise figure at low source impedance is required.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	20	V
Collector current (d.c.)	I_C	max.	30	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW
Junction temperature	T_j	max.	125	°C
D.C. current gain at T_j = 25 °C; I_C = 1 mA; V_{CE} = 10 V	h_{FE}	typ.	67	
Transition frequency at f = 35 MHz; I_C = 1 mA; V_{CE} = 10 V	f_T	typ.	200	MHz
Noise figure; I_C = 1 mA; V_{CE} = 10 V; G_S = 20 mΩ^{-1}; f = 1 MHz	F	typ.	3.5	dB
Noise figure; I_C = 1 mA; V_{CE} = 10 V; G_S = 10 mΩ^{-1}; f = 100 MHz	F	typ.	4	dB

MECHANICAL DATA Dimensions in mm



FOR NEW DESIGN THE SUCCESSOR TYPE BF495 IS RECOMMENDED

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	30	V
Collector-emitter voltage (open base) (See also page 4)	V_{CEO}	max.	20	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	V

Currents

Collector current (d.c.)	I_C	max.	30	mA
Collector current (peak value)	I_{CM}	max.	30	mA

Power dissipation

Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW

Temperatures

Storage temperature	T_{stg}		−65 to +125	°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.33	°C/mW

SILICON PLANAR TRANSISTORS FOR VIDEO OUTPUT STAGES

N-P-N transistors in a SOT-32 plastic envelope intended for video output stages in black-and-white and in colour television receivers.

QUICK REFERENCE DATA

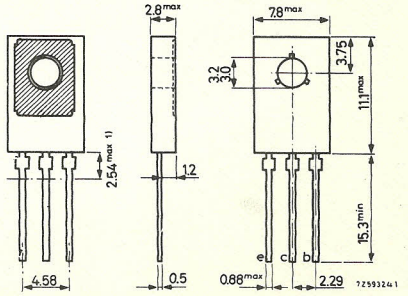
			BF457	BF458	BF459	
Collector-base voltage (open emitter)	V_{CBO}	max.	160	250	300	V
Collector-emitter voltage (open base)	V_{CEO}	max.	160	250	300	V
Collector current (peak value)	I_{CM}	max.	300			mA
Total power dissipation up to T_{mb} = 90 °C	P_{tot}	max.	6			W
Junction temperature	T_j	max.	150			°C
D.C. current gain at T_j = 25 °C; I_C = 30 mA; V_{CE} = 10 V	h_{FE}	>	26			
Transition frequency I_C = 15 mA; V_{CE} = 10 V	f_T	>	90			MHz
Feedback capacitance at f = 1 MHz I_E = 0; V_{CB} = 30 V	$-C_{re}$	<	3.5			pF

MECHANICAL DATA

Dimensions in mm

SOT-32 (TO-126)

Collector connected to metal part of mounting surface



Accessories available: 56333 for insulated mounting; 56326 for non-insulated mounting.

1) Within this region the cross-section of the leads in uncontrolled.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltage			BF457	BF458	BF459	
Collector-base voltage (open emitter)	V_{CBO}	max.	160	250	300	V
Collector-emitter voltage (open base)	V_{CEO}	max.	160	250	300	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	5	5	V

Current				
Collector current (d.c.)	I_C	max.	100	mA
Collector current (peak value)	I_{CM}	max.	300	mA
Base current (d.c.)	I_B	max.	50	mA

Power dissipation				
Total power dissipation up to T_{mb} = 90 °C	P_{tot}	max.	6	W

Temperature				
Storage temperature	T_{stg}		−55 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

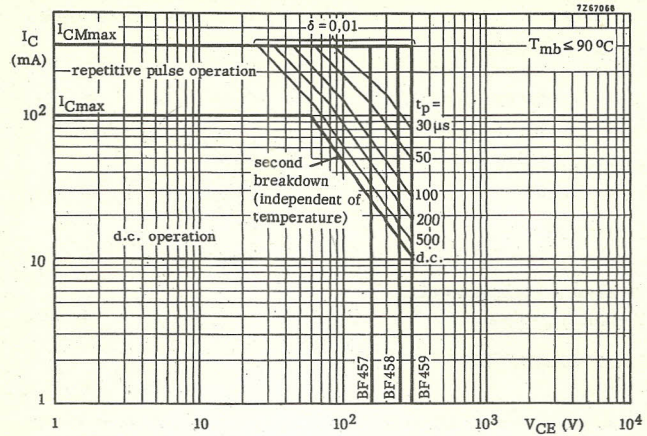
From junction to ambient	$R_{th\ j\text{-}a}$	=	104	°C/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	10	°C/W

CHARACTERISTICS T_j = 25 °C unless otherwise specified

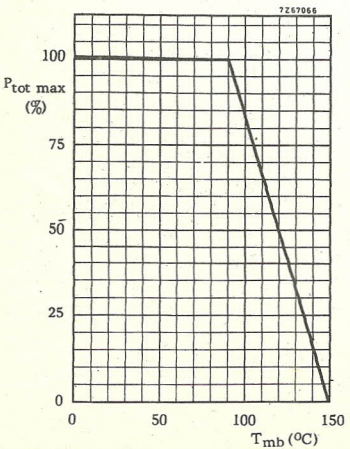
Collector cut-off current				
I_E = 0; V_{CB} = 100 V for BF457 I_E = 0; V_{CB} = 200 V for BF458 I_E = 0; V_{CB} = 250 V for BF459	I_{CBO}	<	50	nA
Emitter cut-off current				
I_C = 0; V_{EB} = 3 V	I_{EBO}	<	50	nA
D.C. current gain				
I_C = 30 mA; V_{CE} = 10 V	h_{FE}	>	26	
Collector-emitter saturation voltage				
I_C = 30 mA; I_B = 6 mA	V_{CEsat}	<	1	V
High frequency knee voltage at T_j = 150 °C				
I_C = 50 mA	V_{CEK}	typ.	15	V

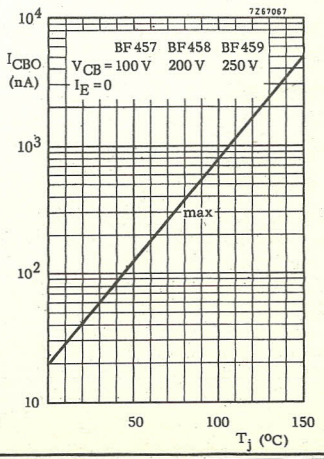
The high frequency knee voltage of a transistor is that value of the collector-emitter voltage at which the small signal gain, measured in a practical circuit, has dropped to 80% of the gain at V_{CE} = 50 V. A further decrease of the collector-emitter voltage results in a rapid increase of the distortion of the signal.

Transition frequency at f = 100 MHz				
I_C = 15 mA; V_{CE} = 10 V	f_T	typ.	90	MHz
Feedback capacitance at f = 1 MHz				
I_E = 0; V_{CB} = 30 V	$-C_{re}$	<	3,5	pF
Output capacitance at f = 1 MHz				
I_E = 0; V_{CB} = 30 V	C_{oe}	<	4,5	pF



Safe Operating Area with the transistor forward biased





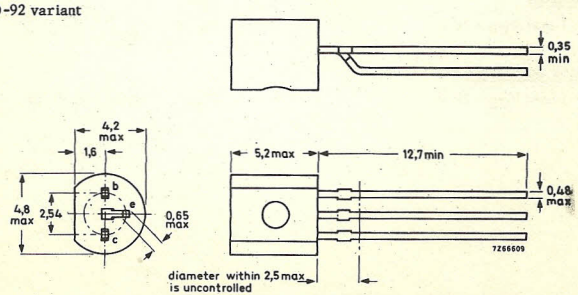
SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a plastic TO-92 variant intended for h.f. applications in radio and television receivers; it is especially recommended for f.m. tuners, low noise a.m. mixer-oscillators with high source impedance and i.f. amplifiers in a.m./f.m. receivers where a high current gain is of importance.

QUICK REFERENCE DATA				
Collector-base voltage (open emitter)	V_{CBO}	max.	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	20	V
Collector current (d.c.)	I_C	max.	30	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	mW
Junction temperature	T_j	max.	150	°C
D.C. current gain at T_j = 25 °C I_C = 10 mA; V_{CE} = 10 V	h_{FE}	typ.	115	
Transition frequency I_C = 1 mA; V_{CE} = 10 V	f_T	typ.	260	MHz
Noise figure at f = 100 MHz I_C = 1 mA; V_{CE} = 10 V; G_S = 10 mA/V	F	typ.	4	dB
Conversion noise figure at f = 1 MHz I_C = 1 mA; V_{CE} = 10 V; G_S = 1,2 mA/V	F_c	typ.	2	dB

MECHANICAL DATA Dimensions in mm

TO-92 variant



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	30	V
Collector-emitter voltage (open base) (See also page 4)	V_{CEO}	max.	20	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	V

Currents

Collector current (d.c.)	I_C	max.	30	mA
Collector current (peak value)	I_{CM}	max.	30	mA

Power dissipation

Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	mW

Temperatures

Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0,25	°C/mW

CHARACTERISTICS T_j = 25 °C

Base-emitter voltage [2])

I_C = 1 mA; V_{CE} = 10 V	V_{BE}		0,65 to 0,74	V

Base current

I_C = 1 mA; V_{CE} = 10 V	I_B		4,5 to 15	μA
		typ.	8,7	μA

Feedback capacitance at f = 0,45 MHz

I_C = 1 mA; V_{CE} = 10 V	$-C_{re}$	typ.	0,85	pF

[1]) V_{BE} decreases by about 1,7 mV/°C with increasing temperature.

CHARACTERISTICS (continued) T_j = 25 °C

Transition frequency

I_C = 1 mA; V_{CE} = 10 V	f_T	typ.	260	MHz

Noise figure

I_C = 1 mA; V_{CE} = 10 V				
G_S = 2 mA/V; f = 0,2 MHz	F	typ.	1,5	dB
G_S = 1,5 mA/V; f = 1,0 MHz	F	typ.	1,2	dB
G_S = 10 mA/V; f = 100 MHz	F	typ.	4	dB

Conversion noise figure

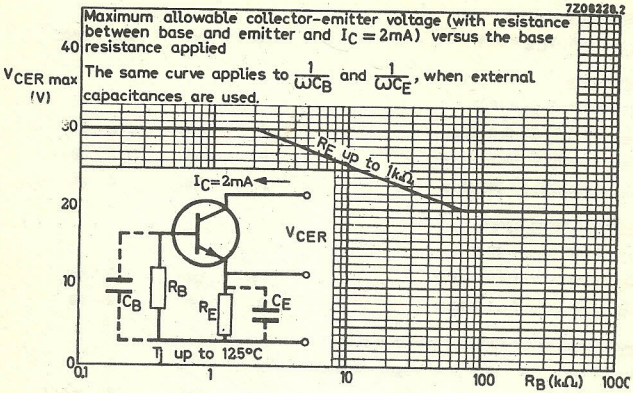
I_C = 1 mA; V_{CE} = 10 V				
G_S = 0,6 mA/V; f = 0,2 MHz	F_c	typ.	3	dB
G_S = 1,2 mA/V; f = 1,0 MHz	F_c	typ.	2	dB

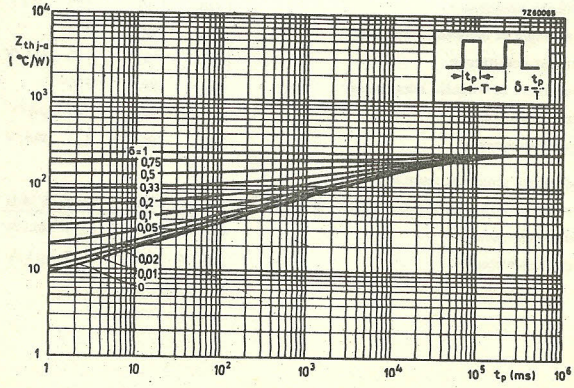
y parameters at f = 100 MHz (common base)

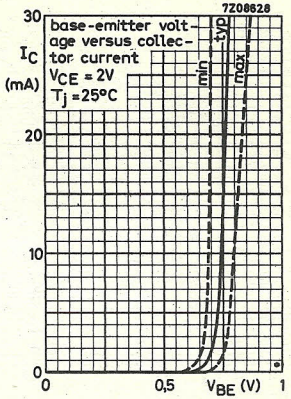
I_C = 1 mA; V_{CE} = 10 V (lead length = 3 mm)				
Input conductance	g_{ib}	typ.	32	mA/V
Input susceptance	$-b_{ib}$	typ.	3	mA/V
Feedback admittance	$\lvert y_{rb} \rvert$	typ.	500	μA/V
Phase angle of feedback admittance	φ_{rb}	typ.	272°	
Transfer admittance	$\lvert y_{fb} \rvert$	typ.	33	mA/V
Phase angle of transfer admittance	φ_{fb}	typ.	150°	
Output conductance	g_{ob}	typ.	22	μA/V
Output susceptance	b_{ob}	typ.	1,1	mA/V

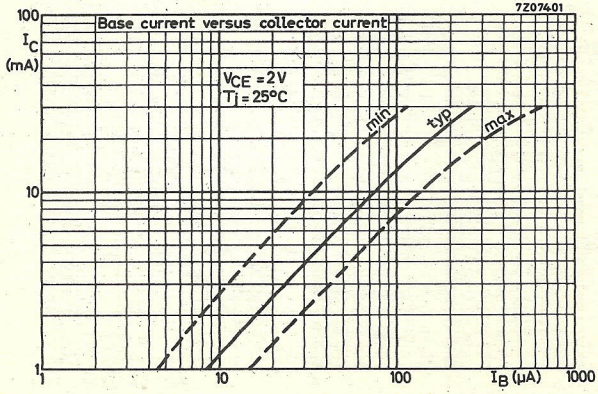
y parameters (common emitter)

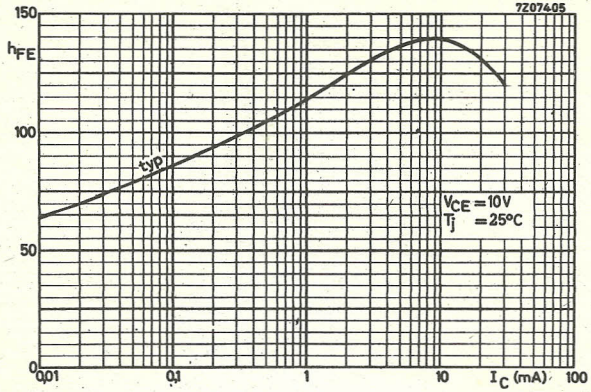
I_C = 1 mA; V_{CE} = 10 V (lead length = 3 mm)		f = 10,7 MHz	f = 0,45 MHz	
Input conductance	g_{ie}	< 0,64	0,54	mA/V
Output conductance	g_{oe}	< 13,5	11,5	μA/V

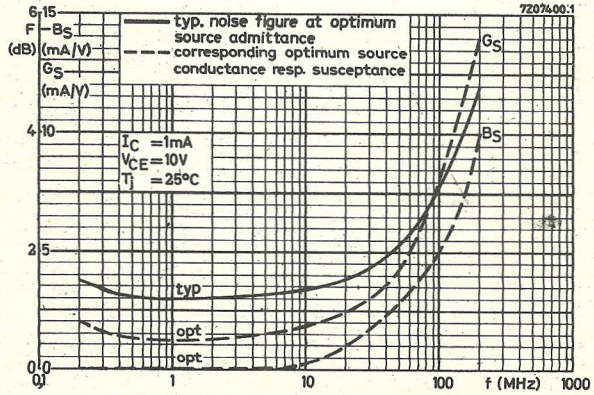

7Z08228.2
Maximum allowable collector-emitter voltage (with resistance between base and emitter and $I_C = 2mA$) versus the base resistance applied
The same curve applies to $\frac{1}{\omega C_B}$ and $\frac{1}{\omega C_E}$, when external capacitances are used.
$V_{CER\ max}$ (V)
R_E up to 1kΩ
I_C=2mA
V_{CER}
C_B
R_B
R_E
C_E
Tj up to 125°C
R_B (kΩ)

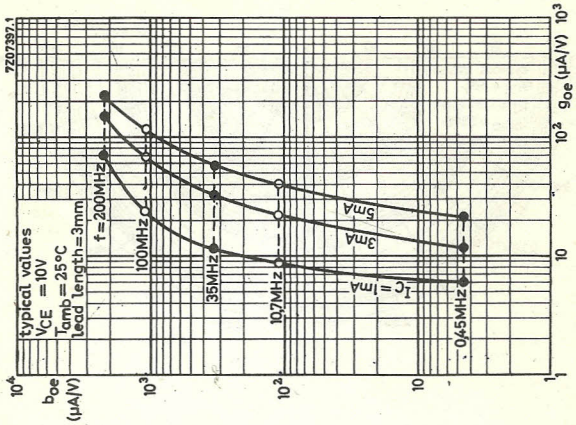

7Z60065
$Z_{th\ j-a}$ (°C/W)
t_p (ms)
δ=1
0,75
0,5
0,33
0,2
0,1
0,05
0,02
0,01
0

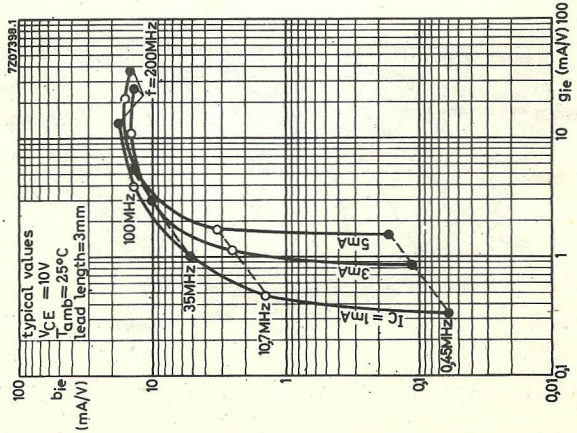

7Z08628
base-emitter voltage versus collector current
V_{CE} = 2V
T_j = 25°C
I_C (mA)
min
typ
max
V_{BE} (V)

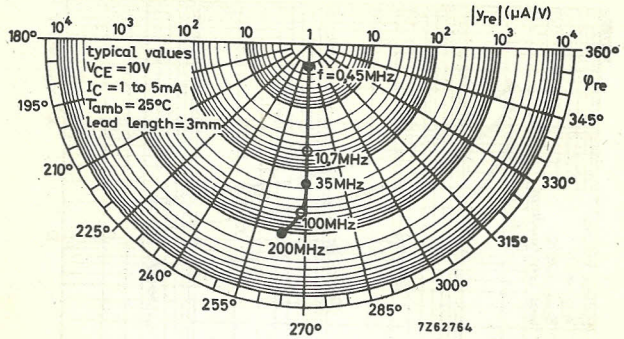

7Z07401
Base current versus collector current
V_{CE} = 2V
T_j = 25°C
I_C (mA)
min
typ
max
I_B (μA)

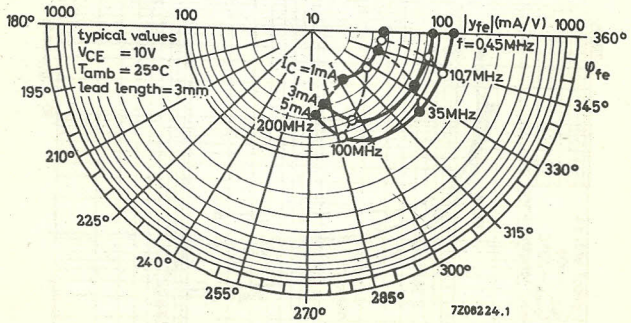

7Z07405
h_{FE}
150
100
50
0
typ
V_{CE} = 10V
T_j = 25°C
0,01
0,1
1
10
I_C (mA)
100


7Z07400.1
F (dB)
B_S (mA/V)
G_S (mA/V)
typ. noise figure at optimum source admittance
corresponding optimum source conductance resp. susceptance
I_C = 1mA
V_{CE} = 10V
T_j = 25°C
G_S
B_S
typ
opt
opt
6
4
2
0
15
10
5
0
0,1
1
10
100
f (MHz)
1000


7Z07397.1
b_{oe} (μA/V)
g_{oe} (μA/V)
typical values
V_{CE} = 10V
T_{amb} = 25°C
lead length = 3mm
f = 200MHz
100MHz
35MHz
10,7MHz
0,45MHz
I_C = 1mA
3mA
5mA
10^4
10^3
10^2
10
1
10^3
10^2
10
1


7Z07398.1
b_{ie} (mA/V)
g_{ie} (mA/V)
typical values
V_{CE} = 10V
T_{amb} = 25°C
lead length = 3mm
f = 200MHz
100MHz
35MHz
10,7MHz
0,45MHz
I_C = 1mA
3mA
5mA
100
10
1
0,1
0,01
10
1
0,1
0,01





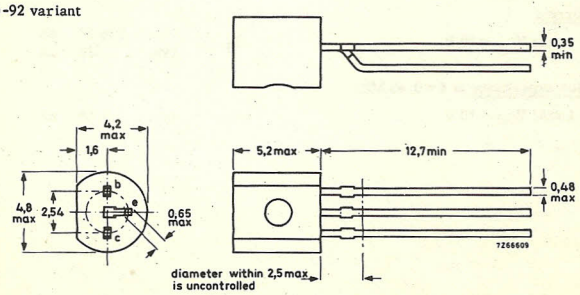
SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a plastic TO-92 variant intended for h.f. applications in radio and television receivers; it is especially recommended for f.m. tuners, i.f. amplifiers in a.m./f.m. receivers where a low transistor output conductance is of importance, a.m. input stages of car radios where a low noise figure at low source impedance is required.

QUICK REFERENCE DATA				
Collector-base voltage (open emitter)	V_{CBO}	max.	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	20	V
Collector current (d.c.)	I_C	max.	30	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	mW
Junction temperature	T_j	max.	150	°C
D.C. current gain at T_j = 25 °C I_C = 10 mA; V_{CE} = 10 V Valores típicos	h_{FE}	typ.	67	
Transition frequency I_C = 1 mA; V_{CE} = 10 V	f_T	typ.	200	MHz
Noise figure I_C = 1 mA; V_{CE} = 10 V G_S = 20 mA/V; f = 1 MHz G_S = 10 mA/V; f = 100 MHz	 F F	 typ. typ.	 3,5 4	 dB dB

MECHANICAL DATA Dimensions in mm

TO-92 variant



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	30	V
Collector-emitter voltage (open base) (See also page 4)	V_{CEO}	max.	20	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	V

Currents

Collector current (d.c.)	I_C	max.	30	mA
Collector current (peak value)	I_{CM}	max.	30	mA

Power dissipation

Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	mW

Temperatures

Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0,25	°C/mW

CHARACTERISTICS T_j = 25 °C

Base-emitter voltage [2])

I_C = 1 mA; V_{CE} = 10 V	V_{BE}		0,65 to 0,74	V

Base current

I_C = 1 mA; V_{CE} = 10 V	I_B		8 to 28	μA
		typ.	15	μA

Feedback capacitance at f = 0,45 MHz

I_C = 1 mA; V_{CE} = 10 V	$-C_{re}$	typ.	0,85	pF

[1]) V_{BE} decreases by about 1,7 mV/°C with increasing temperature.

CHARACTERISTICS (continued) T_j = 25 °C

Transition frequency

I_C = 1 mA; V_{CE} = 10 V	f_T	typ.	200	MHz

Noise figure

I_C = 1 mA; V_{CE} = 10 V				
G_S = 20 mA/V; f = 1 MHz	F	typ.	3,5	dB
G_S = 10 mA/V; f = 100 MHz	F	typ.	4	dB

Conversion noise figure

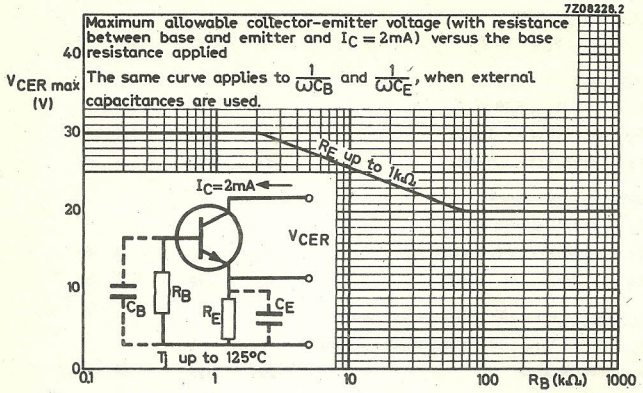
I_C = 1 mA; V_{CE} = 10 V				
G_S = 1,2 mA/V; f = 0,2 MHz	F_c	typ.	4	dB
G_S = 1,5 mA/V; f = 1 MHz	F_c	typ.	2,5	dB

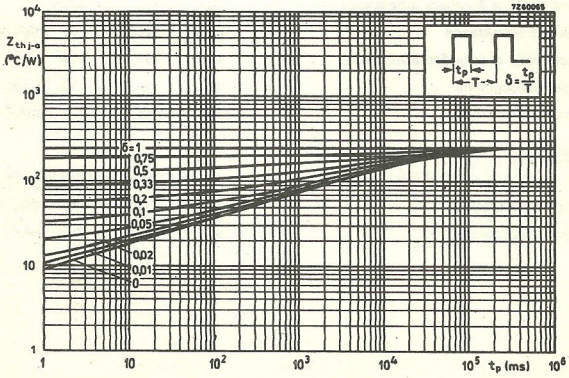
y parameters at f = 100 MHz (common base)

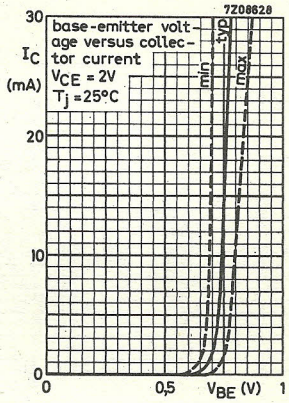
I_C = 1 mA; V_{CE} = 10 V (lead length = 3 mm)				
Input conductance	g_{ib}	typ.	34	mA/V
Input susceptance	$-b_{ib}$	typ.	1	mA/V
Feedback admittance	$\lvert y_{rb} \rvert$	typ.	490	μA/V
Phase angle of feedback admittance	φ_{rb}	typ.	272°	
Transfer admittance	$\lvert y_{fb} \rvert$	typ.	34	mA/V
Phase angle of transfer admittance	φ_{fb}	typ.	144°	
Output conductance	g_{ob}	typ.	12	μA/V
Output susceptance	b_{ob}	typ.	1,1	mA/V

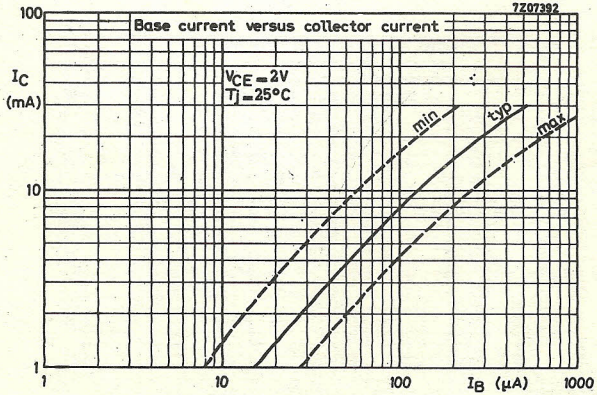
y parameters (common emitter)

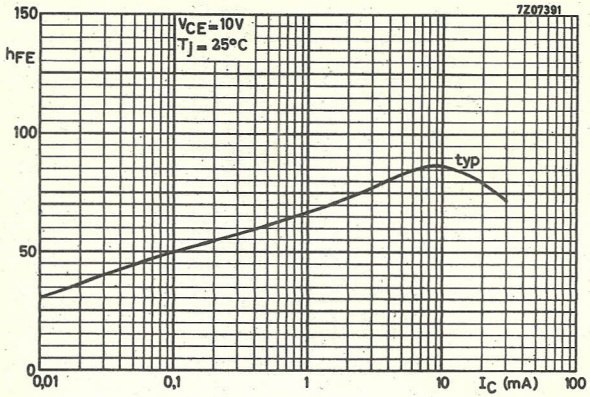
I_C = 1 mA; V_{CE} = 10 V (lead length = 3 mm)		f = 10,7 MHz	f = 0,45 MHz	
Input conductance	g_{ie}	< 0,96	0,86	mA/V
Output conductance	g_{oe}	< 9,5	7,0	μA/V

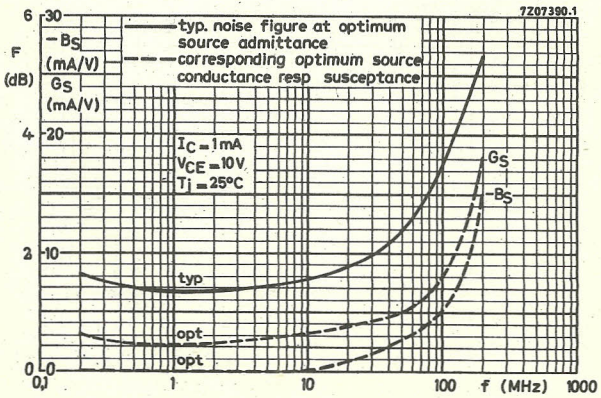

7Z08228.2
Maximum allowable collector-emitter voltage (with resistance between base and emitter and $I_C = 2mA$) versus the base resistance applied
The same curve applies to $\frac{1}{\omega C_B}$ and $\frac{1}{\omega C_E}$, when external capacitances are used.
$V_{CER\,max}$ (V)
R_E up to 1kΩ
I_C=2mA
V_{CER}
C_B
R_B
R_E
C_E
Tj up to 125°C
R_B (kΩ)

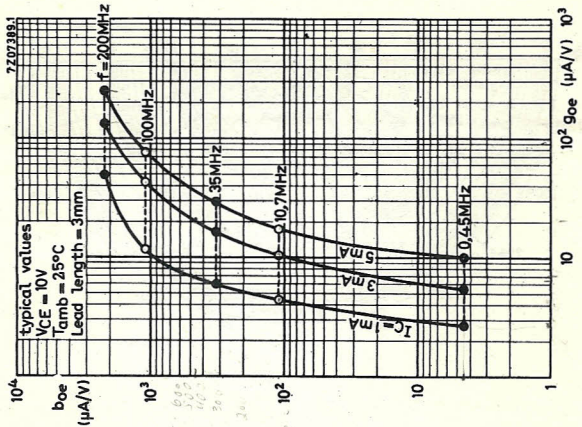

7Z60065
$Z_{th\,j-a}$ (°C/W)
t_p
T
$\delta = \frac{t_p}{T}$
δ=1
0,75
0,5
0,33
0,2
0,1
0,05
0,02
0,01
0
t_p (ms)

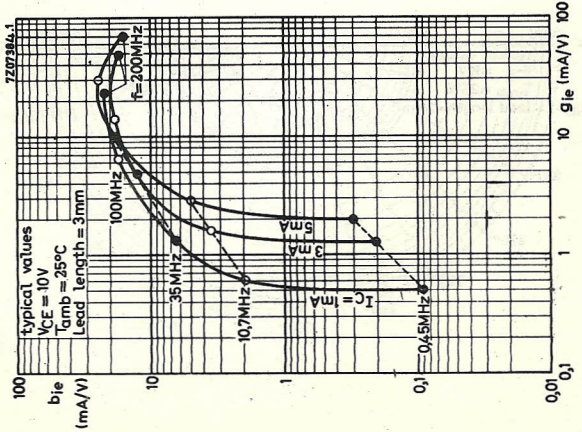

7Z08628
base-emitter voltage versus collector current
V_{CE} = 2V
T_j = 25°C
I_C (mA)
min
typ
max
V_{BE} (V)

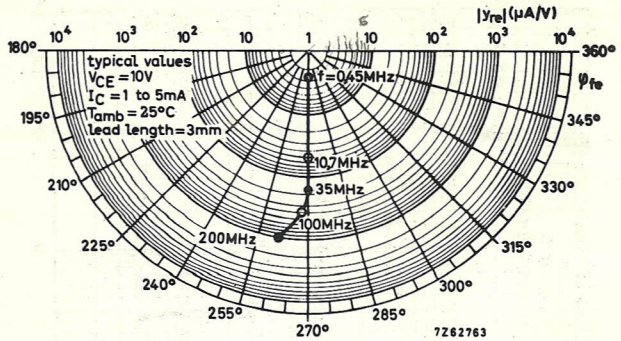

7Z07392
Base current versus collector current
V_{CE} = 2V
T_j = 25°C
I_C (mA)
min
typ
max
I_B (μA)

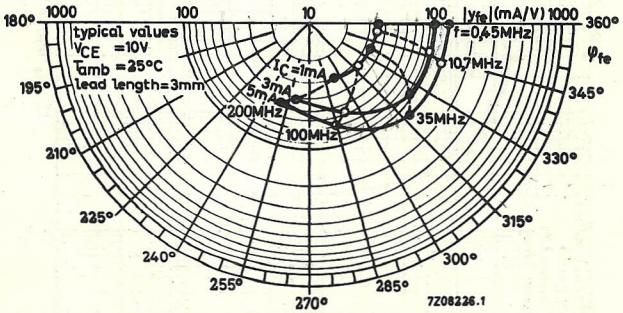

7Z07391
V_{CE} = 10V
T_j = 25°C
h_{FE}
typ
150
100
50
0
0,01
0,1
1
10
I_C (mA)
100


7Z07390.1
typ. noise figure at optimum source admittance
corresponding optimum source conductance resp susceptance
F (dB)
$-B_S$ (mA/V)
G_S (mA/V)
I_C = 1mA
V_{CE} = 10V
T_j = 25°C
G_S
$-B_S$
typ
opt
opt
6
4
2
0
30
20
10
0
0,1
1
10
100
f (MHz)
1000


7Z07389.1
typical values
V_{CE} = 10V
Tamb = 25°C
Lead length = 3mm
f = 200MHz
100MHz
35MHz
10,7MHz
0,45MHz
I_C = 1mA
3mA
5mA
b_{oe} (μA/V)
g_{oe} (μA/V)
10^4
10^3
10^2
10
1


7Z07346.1
typical values
V_{CE} = 10V
Tamb = 25°C
Lead length = 3mm
f = 200MHz
100MHz
35MHz
10,7MHz
0,45MHz
I_C = 1mA
3mA
5mA
b_{ie} (mA/V)
g_{ie} (mA/V)
100
10
1
0,1
0,01





HIGH FREQUENCY PACKAGE

The high frequency package 40835 contains three silicon transistors selected from the BF494 and BF495 products.
The BF494B is intended for use as mixer-oscillator transistor,
the BF495C for controlled first i.f. transistor,
the BF495D for second i.f. transistor.
The low h_{FE} spread of the transistors makes it possible to apply current biasing (one base resistor) and achieve a gain with small spread and low dependence on supply voltage, even at low battery voltages.

QUICK REFERENCE DATA				
Base current				
I_C = 1 mA; V_{CE} = 10 V	BF494B	I_B	5 to 9	μA
	BF495C	I_B	9 to 14	μA
	BF495D	I_B	14 to 26	μA
Conversion noise figure of mixer BF494B				
I_C = 1 mA; V_{CE} = 10 V				
G_S = 1 mA/V; f = 1 MHz		F_c	typ. 2	dB

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Base current

I_C = 1 mA; V_{CE} = 10 V	BF494B	I_B	5 to 9	μA
	BF495C	I_B	9 to 14	μA
	BF495D	I_B	14 to 26	μA

Conversion noise figure of mixer BF494B

I_C = 1 mA; V_{CE} = 10 V

G_S = 1 mA/V; f = 1 MHz F_c typ. 2 dB

y parameters (common emitter)

I_C = 1 mA; V_{CE} = 10 V (lead length = 3 mm)			f = 10,7 MHz			f = 0,45	MHz
Input conductance	BF494B:	g_{ie}	<	0,5		0,4	mA/V
	BF495C:	g_{ie}	<	0,64		0,54	mA/V
	BF495D:	g_{ie}	<	0,95		0,85	mA/V
Output conductance	BF494B:	g_{oe}	typ.	10		6,5	μA/V
			<	13,5		11,5	μA/V
	BF495C:	g_{oe}	typ.	6,5		4	μA/V
			<	9,5		7	μA/V
	BF495D:	g_{oe}	typ.	4		2	μA/V
			<	9,5		7	μA/V

FOR THE REMAINING DATA OF THE INDIVIDUAL TRANSISTORS PLEASE REFER TO THE DATA SHEETS OF THE BF494 AND THE BF495

FOR APPLICATION INFORMATION SEE 40820

in which BF194B must be replaced by BF494B,
BF195C by BF495C,
BF195D by BF495D.

Farid Khalid